



# Hazardous Waste Worker Manual

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# HAZARDOUS WASTE WORKER

Section

## PREFACE

Title

## HOW TO USE THIS MANUAL

### MANUAL OBJECTIVE

The *Hazardous Waste Worker* manual presents training information and other important aspects of what you must know to work safely, effectively, and efficiently on a hazardous waste site. It will instruct you in the types of hazards and situations you can encounter on the job site, the protective measures and equipment you will use, as well as safety and health issues. In addition, this 80-hour course meets the OSHA requirements for 29 CFR 1910.120 certification.

### HOW TO USE THIS MANUAL

The manual introduces you to the topics covered in OSHA's Hazardous Waste Operations and Emergency Response Standard 29 CFR 1910.120 and examines how this standard affects you on the job. Each **Section** covers a major component of the job. Concepts you will learn in each section are listed at the beginning as **Trainee Objectives**. At the end of each section, you will be expected to complete an **Assignment Sheet**. In addition, several sections include **Standard Operating Procedures**, which are hands-on exercises to help you become familiar with various procedures and equipment.

At the back of the manual, you will find a copy of OSHA standards necessary to your job as a hazardous waste worker. The **Appendix** section also contains additional information on understanding regulations and accessing OSHA. Words and acronyms that are *italicized* in the text, are found in the **Glossary** with their definitions.

### THANK YOU

Thank you for placing your trust in Laborers-AGC training manuals. We believe this manual will instruct you in the most significant, useful, and up-to-date technical information and safety aspects of your job.

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# HAZARDOUS WASTE WORKER

Section

**1**

Title

**HAZARD RECOGNITION**

## TRAINEE OBJECTIVES

After completing Section 1, you will be able to:

1. Match the following words with the proper definition or example:

Air reactive materials  
Biological waste  
Chemical reactivity  
Combustible  
Corrosives  
Flammable  
Flammable range  
Flash point  
Oxidizing materials  
Water reactive materials

2. Define the following terms and acronyms:

Accident	Safe work practices
Engineering controls	Toxic
LEL	UEL
LFL	UFL
Safety	

3. Identify two approaches to hazard recognition.
4. Identify the three general categories of hazards on a hazardous waste site.
5. List the four types of chemical hazards.
6. List the three elements of the fire triangle.
7. Explain the difference between combustible and flammable materials.

8. List the physical states in which chemicals are usually found.
9. Identify the five forms of airborne contaminants.
10. List the 12 types of physical hazards.
11. Identify the two types of radiation.
12. Identify safety hazards that are common to both hazardous waste sites and construction sites.
13. List the two main approaches to reducing or preventing accidents.
14. List the three general site safety procedures used on hazardous waste sites.
15. List five conditions to watch for on a hazardous waste work site.
16. Identify three common ways engineering controls seek to eliminate, control, or contain a hazard.

**INTRODUCTION**

Laborers know that construction work of any type can be dangerous. In response, the typical Construction Craft Laborer (CCL) develops a sixth sense for spotting hazards on the job. This skill is developed through experience, training, and sharing stories with co-workers. The ability to recognize and respond to hazards is very important to the health and safety of any worker. Although many aspects of hazardous waste work are similar to other types of construction work, there are also unique aspects to it.

The purpose of teaching hazard recognition is to improve the worker's ability to identify hazards found in hazardous waste work. Recognizing a hazard is an important step in protecting oneself from injury, illness, or death.

**RECOGNIZING HAZARDS**

There are two different approaches to hazard recognition:

- Site characterization – a formal and scientific identification and evaluation of the hazards on a hazardous waste site.
- Common sense – an approach that every worker can use.

**Site Characterization Approach**

Site characterization is the procedure that is followed during the initial investigation of a site to determine the hazards present. This step is critical to the success and safety of the cleanup effort. It requires a team of technical specialists to investigate the site, interpret the results, and develop a program to address the hazards of the specific site. Site characterization involves the following steps:

1. Gather information on the history of the site
2. Survey the boundary of the site
3. Perform an on-site survey
4. Evaluate data and develop a safety and health plan

---

### Gather Information on the History of the Site

The first step involves basic research about the site, such as its location and how it was contaminated. This step involves activities such as:

- Researching company records
- Interviewing former employees and nearby residents
- Reviewing local fire, police, and court records, etc.
- Gathering information on geology and terrain, the nearby population, and access routes

### Survey the Boundary of the Site

After basic research on the site has been conducted, specially trained workers visit the site to monitor for possible hazards. These technical specialists do not go onto the site. Instead, a survey is done around the boundary of the site. Observations are made of conditions on the site. Air samples are taken at the edge of the site to gather further information about potential hazards. Soil and water samples also may be collected for analysis.

### Perform an On-Site Survey

During the on-site survey, technical experts go on the site to perform further hazard evaluation. Because the exact nature of the hazards is still unknown at this point, these workers wear the highest level of personal protective equipment (PPE) required. Working in teams, they perform additional air, water, and soil sampling. They also put together an in-depth inventory of any container locations, evaluate the conditions of the wastes, and try to identify the presence of unusual hazards, such as highly corrosive materials. Metal detectors and ground penetrating radar may be used to locate buried wastes. Sometimes photographs are used to further document site conditions.

### Evaluate All Data and Develop a Safety and Health Plan

Once the on-site survey is done, all the relevant information is examined and reviewed. The goal is to develop a profile of the site hazards. The different materials found at the site are analyzed so that the chemical composition can be established. A *material safety data sheet (MSDS)* is used for each chemical to determine its chemical properties, from flammability limits to Occupational Safety and Health Administration (OSHA) exposure levels. This information is then used to determine what types of PPE will be needed by CCLs and other workers on the site during clean-up activities.

It is important to realize that site characterization is not finished at this point. Rather, it continues for the duration of the job.

Workers are briefed on the site characterization. This site-specific briefing gives workers the chance to familiarize themselves with the types of chemicals on-site, the hazards to expect, and the PPE that is needed. The location of the wastes, the type of terrain, and the safety features of the site plan all are reviewed. The briefing is a good time for workers to ask questions about the hazards of that specific site.

### **The Common Sense Approach**

There are many types of potential hazards on hazardous waste sites. The ability to spot these hazards is an important skill for workers to have. By using a common sense approach, workers gain a basic understanding of the actual site hazards, as well as potential hazards by asking themselves the following questions:

- Are there areas of dead vegetation or dead animals? This is an indicator that chemicals are likely to be found.
- Are barrels, drums, tanks, or other containers present? Do any of the containers appear to be leaking? Are they corroded or bulging?
- Are there pits, ponds, or lagoons present? Are there discolorations or any indication that chemicals are present?
- Can chemical odors be detected?
- Are there any safety hazards such as trenches?
- Are there obstacles or debris in the area?
- Are drums stacked in an unstable manner?

### **The Limitations of the Common Sense Approach**

While several types of hazards may be openly observed (e.g., safety hazards), it is important to remember that observation alone can lead to a false sense of security. Common sense alone is not enough for these jobs. Some sites look perfectly safe. Drums may be buried or chemicals may be present at levels too low to be detected

by smell or have no warning properties. It is important to understand that the common sense approach has limitations. Hazardous waste sites are unique in that hazards are hidden and must be investigated carefully. These hidden hazards make hazardous waste work more dangerous than other construction work.

## **TYPES OF HAZARDS**

A hazardous waste site contains a variety of hazards, which can be grouped into three general categories:

1. Chemical hazards
2. Biological hazards
3. Physical hazards

## **CHEMICAL HAZARDS**

It is important to know why many chemicals are considered hazardous. The information will help workers to better understand the hazards and the important role of site characterization and drum sampling.

The presence of chemicals creates a number of hazards for workers on a hazardous waste site. While almost any type of landfill has chemicals in it, hazardous waste sites tend to have much higher chemical contents. Chemical hazards include the following:

- Toxic chemicals
- Corrosives
- Carcinogens
- Reactivity hazards

## **Toxic Chemicals**

A *toxic chemical* is a poisonous substance. Chemicals are considered toxic if they are capable of causing damage to the health of people or wildlife. In reality, all chemicals are potentially hazardous. From a toxic standpoint, chemicals may be only slightly dangerous, such as acetone or highly dangerous, such as hydrogen cyanide.

To understand how hazardous a chemical is, the following information is needed:

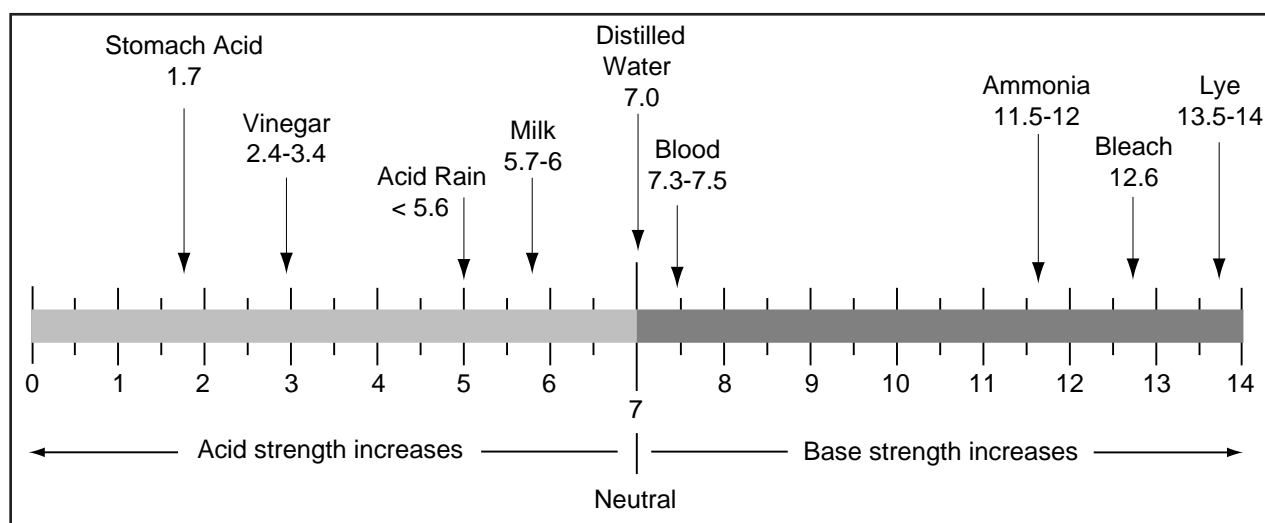
- Toxicity of the chemical
- Exposure time to the chemical
- Concentration of the chemical

**Corrosives**

A *corrosive chemical* attacks and destroys the material it comes in contact with. Common corrosive chemicals are acids, bases (*caustics*), and halogens. They produce a destructive chemical change, whether it be on wood, rubber, steel, or skin. Some examples of corrosives are:

- Acids
  - Acetic acid
  - Sulfuric acid
  - Hydrochloric acid
  - Nitric acid
- Bases (caustics)
  - Sodium hydroxide
  - Potassium hydroxide
- Halogens
  - Iodine
  - Fluorine
  - Chlorine

The *pH (potential of hydrogen)* scale indicates corrosive strength (Figure 1-1). It ranges from 0 to 14. The strongest acid has a pH of 0. As the pH number increases, the strength of the acid decreases. The midpoint of the scale is 7, which is neutral. As the numbers increase past 7, caustic strength increases, with 14 being the strongest *base*.



**Figure 1-1.** This pH Scale shows the pH Value of some common substances.

Acid rain is an example of acidity in the environment. Water is normally close to a neutral pH of 7. Acid rain is defined as precipitation having a pH of 5.6 or lower. When acid rain falls on lakes and ponds, it lowers the neutral pH of the water. The increased acidity can kill fish, vegetation, and wildlife.

In addition to acids and bases, halogens are also very strong corrosives. They do not occur freely in the environment because they react too easily with other chemicals. They form dangerous compounds that are often encountered on hazardous waste sites. Extreme caution is necessary when handling halogen compounds because they bond easily with hydrogen to form acids. For example, chlorine and bromine bond with hydrogen to form hydrochloric acid and hydrobromic acid, two of the strongest acids known.

There are several things to know about corrosives:

- Adding water to a strong corrosive results in a weaker corrosive. A 90% solution of acetic acid destroys skin. A 6% solution of acetic acid is called vinegar and is safe to eat on a salad.
- Acids and bases tend to neutralize each other. If a strong acid is mixed with a strong base, the resulting solution would be neutral. However, this should **never** be done without technical guidance because of the possible violent reaction and tremendous release of heat due to the reaction.
- Corrosive materials break down steel containers. This means there is a greater hazard in handling old drums filled with corrosives than new drums.

Testing for the pH level is done during drum sampling. There are three main reasons for doing pH testing:

1. Drums containing corrosives must be reported as part of the site characterization survey so precautions can be taken.
2. If drums contain acids and bases, they must be separated and kept away from any drums that

contain cyanides and sulfide wastes. An acid mixed with cyanide forms deadly cyanide gas. Cyanide wastes are produced by many metal treatment processes, so they are fairly common in hazardous waste sites. Deadly hydrogen sulfide gas is given off when mild acids are mixed with sulfide wastes. Sulfide wastes are also common.

3. Weak acids and bases (sulfide- and cyanide-free bases) are sometimes blended together on-site to neutralize them. This must be done with great care and **only** under the direct supervision of a technical expert such as a chemist. Neutralization can lower the disposal costs for these wastes.

## Carcinogens

Chemicals that cause cancer are called carcinogens. In its 9th Report on Cancer, the National Toxicology Program lists 65 agents, substances, mixtures, and exposure circumstances that are known to cause cancer. Additionally, they list 153 agents, substances, mixtures, and exposure circumstances as potential causes of cancer.

Determining the cause of cancer in humans is difficult. There is usually a long period between exposure and the appearance of cancer. This period is called the latency period. The issue of whether or not there is a safe dose for a carcinogen is controversial within the scientific community. Some scientists believe any exposure, no matter how small, carries some risk.

## Reactive Hazards

A chemical reactivity hazard is a chemical that is likely to undergo a chemical reaction (change) that produces a chemical or physical hazard. For example mixing bleach and ammonia produces chlorine gas, a toxic chemical. Calcium carbide and water produce acetylene gas, which is flammable.

Chemicals are *compatible* when they can exist in close and permanent association with each other and not create a hazard. If chemicals are combined in a chemical reaction that results in a hazard, then the chemicals are said to be *incompatible*. Many operations on waste sites involve the mixing of or contact between different chemicals. It is important to know ahead of time if

chemicals are incompatible so precautions can be taken to ensure they are kept separate. Compatibility tests are done to identify incompatible chemicals.

## Physical States

Chemicals are usually found in one of three physical states. These states are:

- Solid
- Liquid
- Gas

A chemical's state determines how exposure occurs and what parts of the body will be affected. For example, chemicals that are gases can be inhaled and will probably affect the lungs. Liquids are more likely to be absorbed by the skin.

### Solids

Solids have a definite shape and volume. They can present different types of hazards. A large solid, like a concrete block, may cause a physical hazard such as tripping or falling. Small solids may be health hazards if they're inhaled. An example is the solid particles produced when cutting a concrete block with a saw. Some solids may be so small they can only be seen with a microscope. Road dust, dust from pavement cutting, and pesticide powders are all examples of solids that can be health hazards.

### Liquids

A liquid is a material that flows and takes the shape of its container. Most liquids become solids at low temperatures and gases at high temperatures. For example, water is a liquid at normal room temperatures, becomes a solid at 32°F (0°C) and turns to a gas at 212°F (100°C).

Some liquids form gases at normal temperatures. The gases are called *vapors*. Every liquid has a *vapor pressure* which determines how easily a liquid gives off vapors. A liquid with a low vapor pressure gives off vapors slowly, such as heating oil. A liquid with a high vapor pressure gives off vapors easily, such as gasoline and toluene. These liquids are considered *volatile*. Liquids that are volatile (have high vapor pressures) are more hazardous because the vapors can be flammable, explosive, or cause adverse health effects.

On a hazardous waste site liquids can be fire, explosive, corrosive or reactive hazards. Examples of hazardous liquids are gasoline, benzene, and hydrochloric acid.

## Gases

Gases have no definite shape or volume—they expand to fill their containers. They mix with air at normal temperatures. Nearly all gases become liquids or solids if cold enough. Some chemicals are in both the liquid and gas forms at normal temperatures. For example, gasoline is a liquid at normal temperatures and also gives off vapors.

*Vapor density* is the weight of a vapor or gas compared to the weight of an equal volume of air. Air has a vapor density of 1. Gases and vapors that are lighter than air have a vapor density less than 1. For example, methane has a vapor density of 0.554. Gases and vapors that are heavier than air have a vapor density greater than 1. Hydrogen sulfide (sewer gas) has a vapor density of 1.189.

Because gases and vapors behave like air, they move quickly and present special hazards. For example, a hazardous gas that is heavier than air can settle in the bottom of a trench, creating a *hazardous atmosphere*. Gasoline vapors can travel a hundred feet or more to an ignition source before they ignite and race back to the liquid source.

## Airborne Contaminants

Worker exposures are often the result of airborne contaminants such as dusts, fumes, gases, mists, or vapors. Each of these contaminants have different actions and physical properties.

## Dusts

Dusts are solid particles suspended in air. They are produced by crushing, grinding, sanding, sawing, or the impact of materials against each other.

## Fumes

Fumes are solid particles in the air, just as dust is. They are usually formed when metals are heated to their melting points, especially during welding or soldering. Chromium and nickel exposures are found when fumes are generated from stainless steel that is arc welded. In

plumbing, lead fumes were produced when molten lead was used. Lead fumes are also generated by melting lead to make fishing sinkers.

Fumes may also be produced by heating asphalt during road paving. An ingredient used in this process is called coal tar pitch. Fumes from coal tar pitch are a serious cancer threat.

## Gases

There are numerous examples of hazardous gases. Some gases, such as methane, may cause workers to suffocate by displacing the oxygen in the air. Many fatalities have occurred due to the improper entry of confined spaces, such as underground silos containing manure. As the manure decays it generates methane gas that displaces the oxygen. Workers may be exposed to some gases without knowing it. Carbon monoxide is a by-product of the internal combustion engine. It is a gas formed by burning carbon-containing materials such as coal, oil, gasoline, wood, or paper. The chief source of carbon monoxide in the environment is the automobile. Carbon monoxide has no warning properties. It is odorless and colorless, and doesn't irritate the nose, eyes, throat, or lungs.

## Mists

Mists and fogs are fine droplets of liquid suspended in the air. Fogs may be created by vapors condensing to the liquid state. Mists are droplets being splashed or sprayed. Examples of mists in construction include oil mist sprayed onto concrete forms, and paint spray mists.

## Vapors

Vapors are gaseous forms of certain materials that are usually solid or liquid at room temperatures. Vapors may be formed when liquids or solids are heated. Some materials, such as solvents, form vapors without being heated. A solvent vapor exposure is one of the most common exposures on hazardous waste or construction sites. Mercury is an example of a metal that vaporizes at room temperature and can be a serious health hazard.

**BIOLOGICAL  
HAZARDS**

Biological hazards either are infectious waste or related to the physical environment of the hazardous waste site. Infectious waste normally comes from hospitals and medical laboratories. In the past, such waste was discarded with few precautions. Currently, regulations require that infectious waste be disposed of in special red bags. The bags are marked with the international biohazard symbol. Like chemicals, infectious waste can be scattered throughout an area by wind and water. Special precautions should be taken when handling biological waste.

Sometimes animals and insects on the site play a role in the infection process. For example, rodents at the site can be carriers of the rabies virus. Certain types of ticks carry microorganisms that cause Rocky Mountain Spotted Fever and Lyme disease. Unlike chemicals, biological hazards contain living organisms which use the body as a host.

In addition, plants and wildlife present their own natural hazards. Poison ivy, poison oak, and poison sumac can cause severe skin irritations. Depending upon the region of the country, workers may also have to watch out for various poisonous reptiles and spiders, such as rattlesnakes, copperhead snakes, and scorpions.

Biological wastes are not usually found mixed with industrial wastes. Sludges from sewage treatment plants are the exception. They tend to resemble other chemical wastes in appearance.

Precautions for biological hazards are similar to those for chemicals—skin and respiratory protection are required. Workers should take special care to ensure that cuts or scrapes are not exposed in any way.

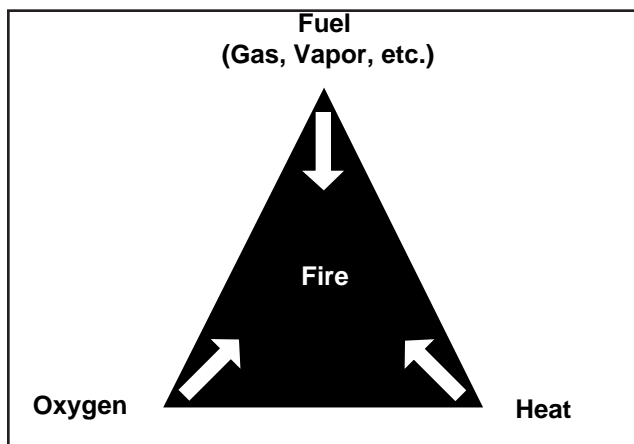
**PHYSICAL HAZARDS**

A physical hazard is any harmful levels of electromagnetic radiation, noise, vibration, temperatures, or light. This also includes any chemicals classified as the following:

- Combustible liquid
- Compressed gas
- Explosive
- Flammable
- Organic peroxide
- Pyrophoric
- Unstable or water reactive

**Fire Hazards**

Fire requires three elements—fuel, oxygen, and heat. These three elements are represented by the fire triangle (Figure 1-2). If any one of the three elements is removed or missing, fire is not possible. For example, water puts out a fire by removing the heat, while a fire blanket smothers a fire by removing the oxygen.



**Figure 1-2.** Fire requires fuel, heat, and oxygen.

Many materials on a hazardous waste site can act as fuel for a fire. These materials are classified as either flammable or combustible. They give off vapors that mix with the oxygen in the air. These vapors burn and are able to sustain a fire. (Note: It is the vapors that burn and not the liquid.)

The difference between a combustible material and a flammable material is the temperature at which the material releases enough vapors to sustain a fire. This temperature is called its *flash point*.

Flash point is the lowest temperature at which a material gives off enough vapors to form an ignitable mixture with the air. A material's flash point indicates its flammability. A low flash point means a high flammability because vapors are released at a lower temperature. Many solvents, such as acetone, have flash points that are lower than room temperature. These solvents are highly flammable.

The Department of Transportation (DOT) defines flammable and combustible materials as follows:

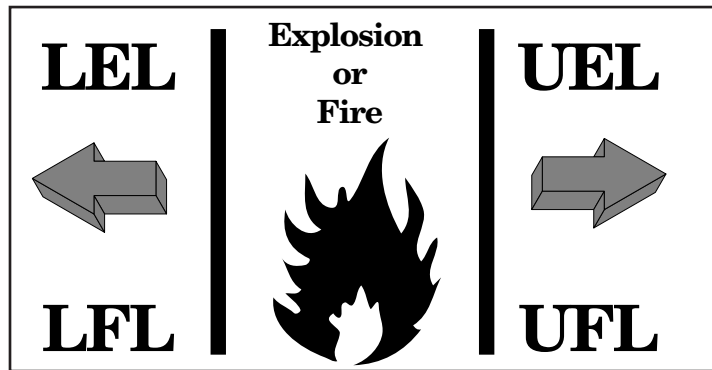
- Flammable material – any material with a flash point below 100°F (37.8°C).
- Combustible material – any material with a flash point between 100°F and 1,500°F (37.8°C and 815.6°C).

To illustrate the difference between flammable and combustible materials consider gasoline versus home heating oil. Gasoline is a flammable liquid and home heating oil is a combustible liquid. Both materials burn. But gasoline is more hazardous because it gives off vapors at normal temperatures.

#### Flammable and Explosive Limits

Another factor related to flammability is the vapor concentration in air. The lowest concentration that can support combustion is called the lower flammable limit (*LFL*). Vapor concentrations lower than the LFL do not contain enough fuel to burn and are said to be too lean. The upper flammable limit (*UFL*) is the highest concentration of vapors that can support a fire. Levels above the UFL are said to be too rich. The fuel displaces the amount of oxygen needed to support a fire.

The concentrations between the LFL and the UFL make up the *flammable range* (Figure 1-3). For example, gasoline vapors have a flammable range of 1.4% to 7.6%. This range is the concentration of fuel vapor necessary to become flammable in the presence of oxygen and an ignition source. Below the fuel vapor level of 1.4%, the mixture of fuel and oxygen is too lean to support combustion. Above 7.6 %, the mixture is too rich to support combustion.



**Figure 1-3.** Explosive and Flammable Ranges

A chemical's explosive range is the same as its flammable range. The lower explosive limit (LEL) is the same concentration as the LFL and the upper explosive limit (UEL) is the same concentration as the UFL. There is only one difference between the two ranges:

- Flammable range refers to materials ignited in open areas.
- Explosive range refers to materials ignited in enclosed or confined spaces.

A flammable material burns in an open area, but it explodes in a confined space. The explosion occurs because energy (heat) builds up in a confined space. This buildup is followed by a sudden release of energy—the explosion.

The following list offers guidelines on what hazardous waste workers need to know about flammability and combustibility.

- Workers do **not** need to memorize flash points or flammable ranges.
- Workers **do** need to know if a material is flammable. The presence of flammable materials should cause workers to proceed with caution.
- Workers **do** have to be careful around flammable chemicals.
- Workers **do** have to be on the lookout for hazards.

The most important precaution is: Do **not** introduce any sparks or flames near a flammable material.

Below are some examples of possible fire hazards.

- A portable gasoline-driven compressor is being used to provide electrical power on a site. The compressor is an ignition source. If it is placed near flammable materials, there could be a fire.
- A worker is digging with a shovel near partly buried drums of flammable liquids. If the shovel hits the drum, the metal-to-metal contact could cause a spark and start a fire. For this reason, special nonsparking tools are used at hazardous waste sites.
- A worker unplugs a piece of electrical equipment near drums of flammable liquids. The act of pulling the plug can produce a spark. The spark would be an ignition source for any vapors escaping from the drums.

**Note:** The electrical system is a common source of sparks. Look for the spark next time when flipping on a light switch in a darkened room.

Hazardous wastes are checked for flammability as part of the drum sampling procedures of the site characterization process.

**Explosive Hazards**

An explosion is the release of energy in a rapid and uncontrolled manner. When an explosion occurs, the heat and gases formed expand rapidly. This expansion creates a shock wave as well as a loud noise. Most often the source of energy is a *chemical reaction*. However, mechanical explosions can occur. Any flammable dust, vapor, or gas can be made to explode under proper conditions. For example, there have been many explosions in grain elevators from something as simple as grain dust. Gunpowder is a more commonly known explosive hazard.

Many chemicals, compounds, and materials have the potential for producing explosions. They are classified as follows:

- Shock sensitive chemicals – Chemicals that explode when subjected to friction, heat, or shock. (Shock is defined as being struck, vibrated, or agitated). These chemicals are highly unstable and must be handled very carefully. Shock sensitive chemicals include nitro compounds, organic peroxides, and organic nitrates.
- Oxidizing materials – Materials that initiate or support combustion in another material. Also called oxidizers, these materials cause fire either through self-reactions or through the release of oxygen or other gases that support combustion in other materials. Examples include chlorates, perchlorates, peroxides, and nitrates.
- Water-reactive materials – Materials that react vigorously or violently with water, steam, and moisture in the air. They can release heat and/or explosive or flammable gases as well as spontaneously explode or burn. Examples include alkali metals, such as potassium, sodium, and lithium, and ammonium sulfide. These materials must be identified and handled carefully, since water is usually present on hazardous waste sites.
- Air-reactive materials – Materials that react violently with air or oxygen and are capable of a rapid release of energy. For example, white phosphorous will burn or explode upon contact with room air. Some air-reactive

materials form peroxides, such as ethers, which are powerful shock-sensitive oxidizers. Air-reactive materials must be stored in nonreactive solutions (such as water) or inert atmospheres (such as nitrogen) at all times.

It is uncommon for metal dusts, grain dusts, or commercial explosives to provide a problem at hazardous waste sites. Usually the problem involves chemicals that react with air or moisture to form explosive by-products. For example, some types of ethers react with moisture to form organic peroxides. Organic peroxides are shock sensitive. In fact, they are more shock sensitive than some commercial explosives such as TNT. Because of the potential for explosions, drums are tested for shock sensitivity early in the site characterization process.

Let us compare two similar situations. In the first situation, a 25-gallon container of benzene begins to burn in the middle of an open field. In the second situation, a similar container of benzene emits flammable vapors in an 8-foot deep trench. The second situation is far more hazardous because the confined area of the trench prohibits gases and heat from escaping and an explosion will occur. Explosions are more likely to cause injuries because of the amount of force and the unpredictable nature of the the released energy.

## **Radiation Hazards**

Some materials are radioactive. This means that the material emits energy in the form of particles or waves. This energy is called *radiation*, of which there are two types—ionizing radiation and nonionizing radiation.

### **Ionizing Radiation**

Ionizing radiation is energy released by radioactive materials in the form of particles or waves that have enough energy to change or destroy living tissue. There are different types of ionizing radiation, and each type of poses a different health hazard.

The four types of ionizing radiation are:

1. Alpha particles
2. Beta particles
3. Gamma rays
4. Neutron particles

**Nonionizing Radiation**

Nonionizing radiation is energy emitted from materials in the form of waves that do not have enough energy to change atoms. Although some health hazards are associated with nonionizing radiation, it is not as dangerous as ionizing radiation.

Examples of nonionizing radiation include:

- Lasers
- Light bulbs
- Power lines
- Radar
- Shortwaves
- Sunlight
- Television waves
- VHF and UHF
- Welding arcs

**Sources**

Radiation hazards on a hazardous waste site come from several sources, such as:

- Hospitals and laboratories – Radioactive chemicals and drugs used for research and medicine end up as biological waste.
- Ammunition facilities – Radioactive materials are used in the production of weapons. Many of these sites are now classified as hazardous waste sites and need to be cleaned up.

Radiation hazards are tested for during the site characterization survey. Professionals, such as a radiation health physicist, radiation protection technician, or health physicist technician, determine and identify the type of radiation hazard that may be present. It is important to remember that radiation has no warning properties. It can't be seen, smelled, or felt.

**Oxygen Deficiency**

The oxygen content of normal breathing air is about 21 percent oxygen by volume. As defined by OSHA, an *oxygen-deficient atmosphere* has an oxygen level below 19.5 percent by volume.

Oxygen deficiency is caused by the following:

- Oxygen consumption – A substance reacts with and uses up the oxygen in the atmosphere.
- Oxygen displacement – Other gases push out the breathable air, which includes the oxygen.

### Oxygen Consumption

Oxygen consumption is the result of chemical reactions or biological processes that use oxygen. A fire is a chemical reaction that uses oxygen. Work such as welding, cutting, or brazing uses up the oxygen in a confined space. A slower form of oxygen consumption is rusting. Rusting is a chemical reaction between iron and the oxygen in the air.

Another example of oxygen consumption involves bacteria. Bacteria are living organisms and need oxygen to live. They are also the reason organic matter decomposes (rots). Garbage dumps, landfills, or swampy areas are all places where decomposition occurs. Excavations and manholes near these areas may have low oxygen levels due to the activity of bacteria.

### Oxygen Displacement

*Oxygen displacement* occurs when a gas is introduced into an area, such as a confined space, and pushes the oxygen out to make room for itself. For example, nitrogen is used to displace the oxygen (one of the three elements of the fire triangle) in an underground storage tank to prevent a fire from occurring during removal.

A *simple asphyxiating atmosphere* is an atmosphere that contains a gas or gases that are nonreactive and nontoxic to the body. However, in sufficient quantity, these gases will displace the oxygen in an area. If enough oxygen is displaced, the atmosphere will not support life. For example, normal breathing air contains about 78% nitrogen. No one is harmed by breathing it. But an atmosphere containing 100% nitrogen will kill anyone breathing it because there is no oxygen present.

**GENERAL SITE  
SAFETY**

Hazardous waste workers face a higher risk of accidents and injury than the typical industrial employee. Often they must deal with situations with little information. In addition, PPE worn to reduce chemical exposures can increase the possibility of accidents for the following reasons:

- Reduced mobility
- Narrower field of vision and reduced clarity
- Reduced communication and hearing capabilities
- Increased heat stress
- Increased reaction time due to physical and mental stress

In short, hazardous waste workers are subjected to many factors that may lower their ability to react, thereby increasing their chances of an accident. To offset these risks, workers can take responsibility for their own safety through awareness and action.

*Safety* is the state of being secure from hurt, injury, or loss. To be safe requires two types of actions—offensive and defensive. By taking the offensive, workers protect themselves against actions they can control. By taking the defensive, workers maintain an awareness of actions or situations that may be created by others or by activities taking place.

**Safety Hazards**

Hazardous waste sites contain many safety hazards that are typical of other types of construction work, such as:

- Acoustic – noise from loud machinery or tools.
- Back injuries - manually moving drums
- Electrical – wiring, equipment, grounding, power lines.
- Engulfment – trenches
- Striking or struck by injuries – slips, trips, falls, hit by a vehicle.
- Thermal – fires, hot pipes, explosions, and equipment

Regulations established by both federal and state agencies cover many of these safety hazards. Employers are required to follow these regulations on **all** job sites, including hazardous waste sites. Regulations that may be familiar from previous work experiences deal with:

- Excavations
- Eye protection
- Grounding electrical equipment
- Hand tools
- Hearing protection
- Ladders
- Lifting
- Lockout/tagout
- Safety belts
- Safety shoes and hard hats
- Scaffolding
- Confined space entry

### **Site Safety Awareness**

General site safety includes a continual awareness of site-related safety concerns. All employees must be aware of site hazards and remain alert to identifying new or additional hazards that may arise as operations progress. Some items to be aware of at the work site include:

- Weather changes. When it gets hot or the air is calm, chemical concentrations in the air can increase. This increase may require additional protection.
- Wind direction. For example, avoid dust and vapors by working upwind if possible.
- Odors that may indicate the presence of chemicals.
- The location of someone who can help if an emergency arises.
- Where and how to exit from every area.

**Safety Procedures**

Safety procedures include the use of safe work practices, engineering controls, and PPE. Employing each of these protective measures as needed helps to ensure a safe working environment for site personnel.

Many practices and controls are common to all hazardous waste sites, while others are specific to the unique hazards of a particular site. Workers should become familiar with each site and its requirements before they begin work. This information is specified in the Site Safety and Health Plan.

**Safe Work Practices**

Safe work practices are habits workers can adopt and use to protect themselves while performing specific duties. Workers should understand that:

- Many safe work practices can be used at different job sites. Workers should continue to follow the safe work practices they already know.
- Effective use of safe work practices depends largely on every worker's conscious effort to work safely.
- Following safe work practices while performing any task will greatly reduce the likelihood of injury or illness to workers.
- Employers will identify safe work practices for any given job so workers will understand how they are to conduct themselves as they perform the work.
- Medicine and alcohol can worsen the effects of exposure to toxic chemicals. Workers should consult their doctors about possible reactions between prescription medicines and exposures to toxic chemicals.
- Personnel and equipment in a contaminated area should be minimal. Only the personnel necessary for effective site operations should be present.
- Work areas for specific work activities must be established.

- Procedures for leaving a contaminated area must be planned and implemented prior to going on the site. Work areas and decontamination procedures must be established on the basis of actual site conditions.

Many of the safe work practices used during hazardous waste work are designed to limit exposure to the hazards found at the site. These practices include the following:

- Reading and fully understanding the Site Safety and Health Plan prior to participating in site activities.
- Eating, drinking, chewing, smoking, or any practice that increases the probability of hand-to-mouth transfer is prohibited in any area designated as contaminated.
- Face and hands must be thoroughly washed upon leaving the work area and before eating, drinking, or any other activities.
- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.
- Excessive facial hair that interferes with a satisfactory fit of the face-to-facepiece seal shall not be allowed on personnel required to wear respiratory protection equipment.
- Contact with contaminated surfaces or with surfaces suspected of being contaminated should be avoided. Whenever possible, do **not**:
  - Walk through puddles, mud, or on other discolored surfaces.
  - Kneel on the ground.
  - Lean, sit, or place equipment on drums, containers, vehicles, or the ground.

Normally, the Site Safety and Health Plan contains safe work practices for specific operations or areas. Three examples of safe work practices that would apply to the entire site or work zones within the site are:

1. Buddy system
2. Site communication
3. Safety meetings

### *Buddy System*

The *buddy system* organizes work groups so that each worker in the group is assigned to observe the activities of at least one other worker in the group. A buddy does the following:

- Provides his or her partner with assistance
- Watches for signs of chemical or heat exposure
- Checks the condition of the partner's PPE
- Alerts others if emergency help is needed

### *Site Communication*

An internal site communication system is required to do the following:

- Alert workers to emergencies
- Pass on safety information (amount of breathing air left, heat stress check, etc.)
- Explain changes in the work to be done
- Maintain overall site control

Verbal communication is often difficult due to wearing PPE and the background noise from heavy equipment. Other audible or visual signals may need to be used. These signals should be known by all individuals before going on site. A primary and a backup system should be set up. Some common communication devices include:

- Radio – citizens band (CB) and FM.
- Noisemakers – bells, sirens, air horns, whistles, and megaphones.
- Visual signals – flags, flares, lights, smoke, and hand signals.

*Safety Meetings*

Site personnel should consider all aspects of site safety before the start of daily activities. A brief safety meeting should be held every day to discuss safety concerns, as well as new and changed activity schedules for the day. Site workers should ask themselves and their supervisor the following questions, and make certain the answers are known before starting work on any given day.

- What PPE is required for the hazardous substances that may be encountered at the work site?
- What potential explosive and/or flammable conditions are present?
- What confined spaces will be entered?
- What emergency equipment is available, where it is located, and how is it used?
- What are the standard operating procedures (SOPs) for evacuation and rescue in an emergency?
- How will workers be notified if conditions or situations change during the work period.
- What is the work/rest cycle for each task?
- What are the prescribed decontamination procedures?
- Where will the buddy system be used and how will workers be paired up?
- Are all workers properly trained and equipped to perform their duties?

*Engineering Controls*

Engineering controls are mechanical devices or systems that are used to reduce or eliminate hazards associated with a certain process or activity. Engineering controls seek to eliminate, control, or contain a hazard before it can reach workers.

There are three common ways to do this:

- The substitution of safer materials, equipment, or processes for more dangerous ones.
- The isolation of hazards from workers by physical barriers, distance, or time.
- The use of ventilation to remove toxic air contamination, or to provide heating or cooling.

Engineering controls include such items as:

- Ventilation hoods
- Automatic equipment shut-offs
- Protective barriers
- Remote controls
- Material handling equipment

These devices allow workers to work around hazardous conditions without being exposed to the hazards. For example, using a ventilation hood while working with evaporating chemicals permits a worker to handle potentially hazardous material without breathing toxic fumes or vapors. Remote controls allow a worker to handle a dangerous operation from a distant location and protect the worker from fires or explosions.

The choice of engineering control is determined by the activity, site location, and site characteristics. For example, ventilation hoods can't be used in an outdoor location. However, pressurized cabs for equipment can be used to provide clean, breathable air for an operator. Machinery that may provide a source of ignition in an explosive or flammable atmosphere can be equipped with spark arrestors or automatic shutoffs. The machinery can be shut down quickly if an immediate evacuation is necessary or an environment becomes explosive in a short period of time. Nonsparking tools can be used so sparks aren't produced from the tool striking or rubbing against metallic materials.

Protective shields or barriers mounted on machinery will protect the operator from explosion or fire while performing site tasks. Also protective barriers placed around an entire operation, such as a drum opening area, protect site workers from the potential hazards of fire and explosion.

Remote-controlled equipment is frequently used at hazardous waste sites, particularly for drum opening and sampling activities. Such equipment should be built so that the mechanism does not provide a source of ignition (e.g., pneumatically or hydraulically driven). Remote controls should be located a safe distance from the work area while still allowing the worker to see the activity.

Material handling equipment includes such items as:

- Drum grapplers and slings
- Shipping packages
- Drum overpacks

Drum grapplers and slings are used to transport drums from one location to another without manually rolling or lifting the drums. They are usually adapted to fork lifts and backhoes equipped with protective shields for operator protection.

Shipping packages come in a variety of shapes and sizes. They're designed to safely hold bottles and other containers for transportation and other handling. These packages usually include absorbent padding and lid locks to prevent spilling or leaking.

Drum overpacks are designed to accept slightly smaller drums or containers that are in an unsafe condition (bulged, ruptured, etc.). They're used to contain materials for shipping, handling, and storage activities.

## Personal Protective Equipment

Unlike engineering controls, PPE does not seek to eliminate, control, or contain a hazard before it can reach workers. PPE should be used only when engineering controls are not feasible or practical. PPE protects a worker from contact with, and exposure to, hazardous

materials and normal construction hazards by placing a barrier or layer of protection between the worker and the hazard. PPE includes the following types of equipment:

- Respirators.
- Chemical protective clothing, such as suits, aprons, gloves, and boots.
- Nonchemical PPE, such as hard hats, safety glasses, and hearing protection.

## ACCIDENTS

An *accident* is an undesirable, unplanned event resulting in physical harm, damage to property, or interruption of business. Accidents may result from:

- An unsafe act, such as moving a leaking barrel or not wearing a respirator properly.
- An unsafe condition, such as an unshored trench or a toxic atmosphere.

These situations may be related. One worker's unsafe act can result in an unsafe condition for someone else.

One example of an unsafe condition involves cylinders of compressed gas. Steel cylinders of oxygen, hydrogen, nitrogen, and air are among the many gases that are used routinely on hazardous waste sites. These cylinders should be stored in an upright position, strapped securely to a permanent structure, and protected from high temperatures. Gases in cylinders are generally safe under such conditions as long as the temperature of the gas does not exceed 125°F. However, if these safety guidelines are not followed and the cylinder is damaged or subjected to high temperatures, it could burst.

## Preventing Accidents

There are two main approaches to reducing or preventing accidents:

1. Eliminate unsafe conditions
2. Reduce unsafe acts

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**Eliminate Unsafe Conditions**

Workers must be aware of conditions that can contribute to accidents and then act to prevent exposure to these conditions. Examples of prevention are enclosing live electrical circuits or providing workers with the proper PPE. Although eliminating unsafe conditions is the best approach, it's difficult to eliminate all unsafe conditions. It's even more difficult to predict or anticipate where such conditions may exist or develop at a hazardous waste site.

**Reduce Unsafe Acts**

Each worker must make a conscious effort to work safely despite the hazardous conditions that may exist at any site. A high level of safety awareness must be maintained so the principles of safety involved in a job become an actual part of the job.



**SECTION 1 - ASSIGNMENT SHEET**

1. Match the following words with the proper definition or example:

- |                                |   |
|--------------------------------|---|
| _____ Air reactive materials   | a. Temperature at which a liquid vaporizes sufficiently to burn when a source of ignition is present. |
| _____ Biological waste         |   |
| _____ Chemical reactivity      | b. Material with a flash point below 100°F (37.8°C).  |
| _____ Combustible              | c. Strong acids and bases.  |
| _____ Corrosives               | d. Materials that break down and form oxygen.   |
| _____ Flammable                | e. Materials that react with air.   |
| _____ Flammable range          | f. When two chemicals react to produce a substance of different composition and properties.           |
| _____ Flash point              |   |
| _____ Oxidizing materials      | g. Material with a flash point between 100°F and 1500°F (37.8°C and 815.6°C).                         |
| _____ Water reactive materials | h. Materials that react with water.   |
|                                | i. Red-bagged viruses and bacteria.   |
|                                | j. Concentrations between the LFL and UFL.  |

2. Define the following terms and acronyms:

Accident \_\_\_\_\_

\_\_\_\_\_

Engineering controls \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

LEL \_\_\_\_\_

LFL \_\_\_\_\_

Safety \_\_\_\_\_

\_\_\_\_\_

Safe work practices \_\_\_\_\_

\_\_\_\_\_

Toxic \_\_\_\_\_

UEL \_\_\_\_\_

UFL \_\_\_\_\_

3. Identify two approaches to hazard recognition.

\_\_\_\_\_

4. Identify the three general categories of hazards on a hazardous waste site.

\_\_\_\_\_

5. List the four types of chemical hazards.

\_\_\_\_\_

\_\_\_\_\_

6. List the three elements of the fire triangle.

\_\_\_\_\_

\_\_\_\_\_

7. Explain the difference between combustible and flammable materials.

\_\_\_\_\_

\_\_\_\_\_

8. List the physical states in which chemicals are usually found.

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9. Identify the five forms of airborne contaminants.

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10. List the 12 types of physical hazards.

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11. Identify the two types of radiation.

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12. Identify safety hazards that are common to both hazardous waste sites and construction sites.

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13. List the two main approaches to reducing or preventing accidents.

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14. List the three general site safety procedures used on hazardous waste sites.

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15. List five conditions to watch for on a hazardous waste site.

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16. Identify three common ways engineering controls seek to eliminate, control, or contain a hazard.

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**APPENDIX 1-1  
TOXIC INFORMATION GUIDE  
PROPERTIES OF CHEMICALS**

<b>Chemical Property</b>	<b>Definition/Description</b>	<b>Examples</b>
Chemical formula	The scientific method used to describe elements and compounds.	Chemical formula of: water = H <sub>2</sub> O methane = CH <sub>4</sub>
Molecular weight	The sum of the atomic weights of the atoms in a molecule.	Molecular weight: water = 18.015 methane = 16.043
Physical state	The state in which a chemical exists at room temperature (about 68° F) and pressure.	Physical state at 68°F (20°C): water = liquid toluene = liquid carbon dioxide = gas
Odor threshold	The minimum concentration of a substance in air that can be detected by the human sense of smell.	Odor threshold concentration: ammonia = 5 ppm ethyl alcohol = 10 ppm carbon monoxide = odorless
Specific gravity	The specific gravity of a chemical is the density of that chemical compared to that of water. If the specific gravity is less than 1, the chemical will float on water. If it is greater than 1, it will sink to the bottom of water.	Specific gravity: water = 1 toluene = .868 sulfuric acid = 1.84
Melting point	Temperature at which chemical changes from a solid to a liquid.	Melting point: water (ice) = 32°F (0°C) polychlorinated biphenyl (PCB) = -2°F (-18.9°C)
Boiling point	Temperature at which a chemical in the liquid state changes from a liquid to a gas at atmospheric pressure.	Boiling point: water = 212°F (100°C) toluene = 231°F (110.7°C) hydrogen sulfide = -76°F (60.2°C)

**APPENDIX 1-1 (continued)**  
**TOXIC INFORMATION GUIDE**  
**PROPERTIES OF CHEMICALS**

<b>Chemical Property</b>	<b>Definition/Description</b>	<b>Examples</b>
Flash point	Lowest temperature at which a material gives off sufficient vapor to form an ignitable mixture and burn when a source of ignition is present. The lower a liquid's flash point, the greater the risk of fire.	Flash point: toluene = 40°F turpentine = 95°F mineral spirits = 102°-140°F
Solubility	The amount of chemical that can be dissolved in water at 68°F. Measured in percent, the higher the percentage, the more chemical that will dissolve in water.	Sugar is 100% soluble in water.
Vapor pressure	As a chemical evaporates, its vapors create pressure, called vapor pressure. Vapor pressure is measured in millimeters of mercury (mmHg) at 68°F and normal atmospheric pressure (760 mm). The higher a chemical's vapor pressure, the greater its tendency to evaporate.	Vapor pressure: water = 17.5 mmHg toluene = 22.0 mmHg mineral spirits = 2.0 mmHg banana oil = 4.0 mmHg
pH	The number which describes whether a chemical is an acid or base and to what degree. pH ranges from 0 to 14, 7 being neutral. Acids have a pH between 0 and 6. Bases (caustics) have a pH between 8 and 14.	pH: water = 7 gastric juices = 1.7 calcium hydroxide (lime) = 12.4



# HAZARDOUS WASTE WORKER

Section

**2**

Title

**HAZARD COMMUNICATION**

## TRAINEE OBJECTIVES

After completing Section 2, you will be able to:

1. Define the following terms or words:

Administrative controls

Substitution

Engineering controls

Time weighted average

2. Identify the following acronyms:

ACGIH

NFPA

DOT

NIOSH

IDLH

PEL

MSDS

TWA

3. List the requirements of the Hazard Communication Standard's written program.
4. List the basic information that must be covered in the employer's training program for hazard communication.
5. List the information an employer must provide each employee.
6. List the exposure control measures that protect workers from exposure.
7. Demonstrate how to use MSDSs by completing an assignment sheet.
8. List the information that must be given on a typical label.
9. List the three basic types of labeling systems.
10. Demonstrate how to read a label by completing an assignment sheet.
11. Calculate TWA and determine exposure levels.



**HAZARD  
COMMUNICATION  
STANDARD**

An effective Hazard Communication Program needs the cooperation of employers and workers. The employer must provide workers with specific information and training about hazardous chemicals in the work area. Workers must use the information and training to recognize chemical hazards in the work area and take steps to prevent exposure.

The Occupational Safety and Health Administration (*OSHA*) has implemented the Hazard Communication Standard for both the construction industry (29 CFR 1926.59) and general industry (29 CFR 1910.1200). The standard states:

“The purpose of this section is to insure that the hazards of all chemicals produced or imported are evaluated and that information concerning their hazards is transmitted to employers and employees.”

These standards require that hazardous chemical manufacturers inform employers about a product’s hazards. The employer must inform all workers who will use or come into contact with the chemical about its hazards.

**Scope**

The Hazard Communication Standard applies to any chemical known to be present in the workplace to which workers may be exposed during normal use. It also applies when exposure to chemicals may occur during a foreseeable emergency. On a hazardous waste site, the standard only applies to the hazardous materials or substances used for the clean-up process. The standard does **not** apply to:

- Hazardous waste
- Tobacco or tobacco products
- Wood or wood products
- Articles (chairs, tables, etc.)
- Food, drugs, and cosmetics
- Alcoholic beverages
- Consumer products

Workers must be trained in the standard because of the hazardous materials they use for cleanup. In order to use the standard correctly, one must know the difference between hazardous substances and hazardous waste.

*Hazardous substances* or materials are any substances or materials which in normal use can be damaging to the health and well-being of workers and the environment. Examples of normal use include processing plant work, manufacturing, and chemical decontamination on hazardous waste sites. Hazardous substances or materials cover a broad range of types, such as toxic, corrosive, and flammable.

*Hazardous waste* is a hazardous substance that has been discarded or otherwise designated as a waste material. It contains the same potential for damaging the health and well-being of workers and the environment.

**Hazard Determination**

The Hazard Communication Standard requires chemical manufacturers, importers, and employers to determine if the chemicals or substances they produce, import, or use in the workplace are hazardous. In most cases, hazard determinations are done by chemical manufacturers before the chemicals are sold to customers.

**Written Hazard Communication Program**

Under the standard, employers and/or contractors must develop, implement, and maintain a written Hazard Communication Program. This written program must be available at the workplace and provide the following information:

- List the hazardous chemicals on the job site.
- Explain how the employer will inform workers of the hazards associated with nonroutine tasks involving hazardous chemicals.
- Explain labels and other forms of warning used by the employer.
- Explain how workers will be provided with material safety data sheets (*MSDSs*).
- Describe the training the employer will use to teach workers about hazardous chemicals.

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### Multiple Employer Sites

Some hazardous waste sites have more than one employer working on the site at the same time. The standard requires that all employers on a multiple employer site provide information to each other on the hazardous chemicals they are using. This sharing of information will help prevent worker exposure to chemical hazards from another employer. The written Hazard Communication Program of a multiple employer site must:

- Explain how MSDSs will be provided to the other employer(s), or identify the location of the MSDSs for each hazardous chemical the other employer's workers may be exposed to while working.
- List the methods an employer will use to inform other employer(s) of measures that need to be taken to protect workers during normal operating conditions and in foreseeable emergencies.
- Explain how the employer will inform the other employer(s) of the hazardous chemical labeling system being used.

The written Hazard Communication Program must be made available upon request to workers, their representatives, and OSHA.

### Information and Training

The Hazard Communication Standard requires employers to provide specific information and training on hazardous chemicals so workers will:

- Be aware of the hazardous chemicals used on the job
- Know how to recognize these hazardous chemicals
- Know the safety issues and health effects of the hazardous chemicals
- Be able to protect themselves

As a minimum, training must cover the following hazard communication information:

- Requirements of the Hazard Communication Standard.

- Operations in the work area where hazardous chemicals are present.
- Location and availability of the:
  - Written Hazard Communication Program
  - List of hazardous chemicals
  - MSDSs for all hazardous chemicals used on site

Employers must provide or ensure that workers have been provided with the following information:

- The ways to detect the presence or release of hazardous chemicals in the work area. A chemical's characteristics are important pieces of information for workers. These characteristics include color, chemical state (solid, liquid, gas), and odor.
- The physical and health hazards caused by exposure to the hazardous chemicals on the job.
- How to protect themselves through work practices, personal protective equipment (*PPE*), and emergency procedures.
- Details of the Hazard Communication Program used by the employer, including labels, lists, MSDSs, and how workers can get and use hazard information.

**Note:** This section covers the general information that must be included in the Hazard Communication Program. The section does not fulfill an employer's obligation to supply workers with hazard communication training on site-specific hazards.

## EXPOSURE GUIDES

When working around hazardous chemicals, exposure is an important consideration. Hazardous chemicals can have devastating health effects on the human body. Therefore, exposure guides are used to inform workers about warnings and exposure limits and to make decisions about worker exposure to chemicals.

Some exposure guides are general. They give instructions or information about a chemical using a short phrase, word, numbers, or symbols. For example,

“avoid skin contact” and “avoid breathing vapors” are general exposure guides. These general guides are usually found on labels or placards on chemical containers. However, the chemical’s identity needs to be known in order for general guidelines to be useful.

When the the employer knows both the identity of a chemical and its air concentration at the work site, more specific exposure guides can be applied. Permissible exposure limits (*PELs*) and threshold limit values (*TLVs*) are two commonly used exposure guides that deal with concentration levels.

Exposure limits set the basis for safe working exposures. In most cases, exposure limits refer to concentrations of a toxic substance in the air over a normal 8-hour work shift. Safe exposure limits represent conditions under which nearly all workers can be repeatedly exposed day after day without adverse acute or chronic health effects.

A product’s MSDS must list chemical exposure limits. The limits may also appear on the product’s container label. Exposure limits usually are given as parts per million (*ppm*) or milligrams per cubic meter (*mg/m<sup>3</sup>*). One ppm is like one drop of chocolate in 14 gallons of milk. Many chemicals can affect your body at 1 ppm or even smaller amounts.

Several organizations have published, required, or recommended safe working guidelines for exposures to hazardous chemicals. These organizations are OSHA, the National Institute of Occupational Safety and Health (*NIOSH*), and the American Conference of Governmental Industrial Hygienists (*ACGIH*).

### **Permissible Exposure Limits**

PELs are exposure guides for airborne concentrations of regulated substances. They set limits upon a worker’s inhalation exposure or the amount of substance a worker can legally breathe in a set amount of time.

There are three ways to represent PELs:

1. Time weighted average
2. Short-term exposure limit
3. Ceiling limit

PELs are the **only** legally enforceable limits because they are set by OSHA. This means that by law, employers must keep a worker's exposure below the PEL. PELs are meant to offer the minimum levels of protection. However, more protective limits are always allowed.

Because PELs refer to inhalation exposures, they can not be used to determine exposure that occurs through the skin. A worker may have an exposure below the PEL but still become overexposed to a chemical through skin absorption.

The skin notation that is sometimes listed in the PELs means a chemical can be absorbed through the skin. It is **not** an exposure guide. There are no concentration guidelines for skin exposure. Therefore avoid skin contact with chemicals whenever possible, especially when the skin notation is used.

**Note:** PELs are important for protecting workers from overexposure to hazardous chemicals. However, workers should be aware of the drawbacks of PELs. Many PELs are not set to protect workers from chronic health effects such as cancer. In addition, PELs that apply to the construction industry were established in 1970. Although OSHA has updated PELs for some substances since that date, such as lead and asbestos, there are many PELs that are outdated.

#### Time Weighted Average

*Time weighted average (TWA)* is the average concentration of a substance in an area over an 8-hour work shift of a 40-hour work week. To determine a TWA, exposure levels are collected over a work shift. The exposure levels are averaged out for 8 hours and the results compared with OSHA's PEL lists. For example, a worker's exposure to toluene is 90 ppm for 2 hours, 120 ppm for 1 hour, and 20 ppm for 5 hours. The worker's actual exposure to toluene, averaged for the day is 50 ppm. The calculations are shown in Figure 2-1. The allowable TWA exposure for toluene is 100 ppm. Therefore, on this particular day, this worker was not overexposed according to OSHA limits.

$$\begin{aligned}\text{TWA} &= \frac{(90 \text{ ppm} \times 2 \text{ hrs}) + (120 \text{ ppm} \times 1 \text{ hr}) + (20 \text{ ppm} \times 5 \text{ hrs})}{8 \text{ hrs}} \\ \text{TWA} &= \frac{180 \text{ ppm hrs} + 120 \text{ ppm hrs} + 100 \text{ ppm hrs}}{8 \text{ hrs}} \\ \text{TWA} &= \frac{400 \text{ ppm hours}}{8 \text{ hrs}} \\ \text{TWA} &= 50 \text{ ppm}\end{aligned}$$

**Figure 2-1.** Calculating the TWA

### *Overtime Calculations*

If a worker works longer than eight hours, overtime calculations must be done to determine the total exposure (Figure 2-2). Overtime does **not** allow an employer to expose a worker to higher concentrations. In fact, the worker must be exposed to lower concentrations because he/she will be working for a longer time period.

#### *Overtime Calculations:*

$$\text{Equation: } \frac{\text{PEL} \times 8 \text{ hrs.}}{\text{hrs. worked}}$$

$$\text{PEL} = 100 \text{ ppm}$$

$$\text{Hours Worked} = 10$$

$$\text{Calculation: } \frac{100 \text{ ppm} \times 8 \text{ hrs}}{10 \text{ hrs}} = 80 \text{ ppm}$$

Worker can only be exposed to 80 ppm for the duration of the time worked.

**Figure 2-2.** Overtime calculations

*Mixture Calculations*

When a worker is exposed to more than one substance or to a mixture of substances that have similar chemical properties, mixture calculations must be done to determine the actual exposure. Chemicals with similar properties have a tendency to attack the same target organs which increases the chance of overexposure. Figure 2-3 gives an example of a mixture calculation.

1. Calculate exposure for each chemical:		Exposure = $\frac{\text{TWA}}{\text{PEL}}$
Benzene	TWA exposure is .5 ppm PEL = 1 ppm	
	$\frac{.5 \text{ ppm}}{1 \text{ ppm}} = 50\% \text{ of PEL}$	
Toluene	TWA exposure is 80 ppm PEL = 100 ppm	
	$\frac{80 \text{ ppm}}{100 \text{ ppm}} = 80\% \text{ of PEL}$	
2. Add exposures for each chemical to find total chemical exposure:		
TOTAL	50% + 80% = 130%	
Exposure is 130% of the PEL so the <b>worker is overexposed.</b>		
Exposure is 30% above the PEL so the <b>worker is overexposed.</b>		

**Figure 2-3.** Mixture calculation for a worker's exposure to benzene and toluene

### Short-Term Exposure Limits

*Short-term exposure limits (STELs)* are the maximum

concentration levels that workers can be exposed to for a short period of time (usually 10 to 15 minutes) without suffering from adverse health effects. These health effects include:

- Irritation
- Chronic or irreversible tissue damage
- Dizziness sufficient to increase the risk of accidents, impair self-rescue, or reduce worker efficiency

STELs should **not** occur more than four times per shift, and there should be at least 60 minutes between exposures. The daily TWA PEL must not be exceeded.

Not all chemicals have assigned STELs. For substances without STELs, it's usually recommended that exposure should not exceed three times the PEL for a short term (10 to 15 minutes). For example, OSHA's PEL for perchloroethylene or perc is 25 ppm. Perc has no STEL listed, so an STEL is estimated by calculating:

$$3 \times 25 \text{ ppm} = 75 \text{ ppm}$$

### Ceiling Limits

*Ceiling limit (c)* is an exposure level that should **never** be exceeded. However, not all chemicals have assigned ceiling values. If a ceiling limit is not assigned to a substance or chemical, it is generally recommended that exposures never exceed five times the PEL.

### Threshold Limit Values

*Threshold limit values* are set by the ACGIH. They are based on the best available information from industrial experience, experimental human studies, and animal studies. The basis on which the values are established may differ from chemical to chemical. TLVs are only advisory and are not legally enforceable. A revised list of TLVs is published each year which makes them more current than PELs. However, chronic effects are not always given enough consideration in setting TLVs.

As with PELs, TLVs refer only to inhalation exposures. There are no concentration guidelines for skin exposure. Steps should be taken to avoid skin contact with chemicals, even if the TLV is within the standard. Overexposure to some chemicals can still occur by skin absorption.

Some chemicals cause adverse health effects if short-period exposures exceed a certain level. Special exposure limits are set for these chemicals. Ceiling limits (c) are levels of concentration or exposure that can never be exceeded. *Immediately dangerous to life or health* (IDLH) values identify an exposure level in an environment that is likely to cause death or serious health effects with very brief exposures.

**EXPOSURE  
CONTROL  
MEASURES**

Exposure control measures were developed to protect workers from chemical exposure and include:

- Substitution
- Engineering controls
- Administrative controls
- PPE

*Substitution* is the most desirable control measure because it eliminates the original hazard. The hazardous chemical is replaced with a nonhazardous or less hazardous chemical that works as well.

*Engineering controls* reduce or eliminate exposures by using mechanical means, such as ventilation systems, acoustical material, and clean air control booths. It does not eliminate the hazard.

*Administrative controls* reduce exposures to an acceptable limit in two ways:

1. Removing the worker from exposure after a specific length of time. This method is used extensively by the nuclear industry to reduce radiation exposures.
2. Establishing work rules, such as no eating, no drinking, or no smoking.

*PPE* is the least desirable exposure control measure because the hazard is still present so exposure is possible. However, it is also the most commonly used method in construction. PPE includes respirators, gloves, protective suits, boots, and other gear that are worn to protect workers from exposures. PPE is not an engineering control.

**INVENTORY LISTS**

Every employer who uses or stores hazardous chemicals on a job site is required to develop and make available a chemical inventory list. This list identifies the potentially dangerous chemicals that workers are exposed to on a work site. The chemical or product name located on the employer's chemical inventory list must be the same as the name on the container label and its corresponding MSDS. In this way, a worker can easily

locate any additional information needed for protection. The inventory list must be on the job site and available for a worker's review. It is updated whenever any new chemical or substance is brought to the site, or if a chemical is no longer used. A sample chemical inventory list is shown in Figure 2-4.

<p style="text-align: center;"><b>THIS COMPANY, INC.</b> <b>111 MAIN STREET</b> <b>ANYWHERE, U.S.A 12345</b></p> <p style="text-align: center;"><b>CHEMICAL INVENTORY LIST</b></p> <p>Acrylic Water Base Paint (Lambert) Ater Blasting Shop Primer Red 53-R-101 Cosmiscoat Pavement Sealer Deck Paint Blue Gray 58-F-23 (Mobile Chemical Co.) Deck Paint Brown 58-D-95 (Mobile Chemical Co.) Deck Paint Ocean Gray 58-F-14 (Mobile Chemical Co.) Duracrylic Extra High Gloss Thinner (PPG Industries) E Enton 37-127 Epoxy Resin (Reichold Chemical) E Enton 37-620 Epoxy Resin Hardener (Reichold Chemical) Paint Thinner 21-263 (PPG Industries) 2 - Propanol Solvent (Fisher) Styrofoam Plastic Forms (Dow Chemical) Varsol 1 Petroleum Solvent (Exxon) Varsol 18 Petroleum Solvent (Exxon)</p>
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**Figure 2-4.** Sample chemical inventory list

## **MATERIAL SAFETY DATA SHEETS**

A *material safety data sheet (MSDS)* is the primary source of information about hazardous chemicals used on a hazardous waste site. Employers are required to have an MSDS for every hazardous chemical used or stored on each job site. They must make the MSDSs available to workers or the workers' union representative for review.

MSDSs come in many different formats, but they all must contain the same basic information. Table 2-1 lists the minimum information that must be contained in every MSDS. Figure 2-5 shows the manufacturer's MSDS for the solvent WD-40®.

**Table 2-1.** Minimum information needed on an MSDS

<b>MSDS Section Title</b>	<b>Information Included</b>
Product Identity and Manufacturer's Information	<ul style="list-style-type: none"> <li>• Identity of the chemical (as on label)</li> <li>• The name and address of the manufacturer</li> <li>• Emergency phone numbers</li> <li>• Date when MSDS was prepared</li> </ul>
Hazardous Ingredients	<ul style="list-style-type: none"> <li>• Hazardous ingredients</li> <li>• Properties of the chemical</li> <li>• Common name and trade name</li> <li>• OSHA PELs</li> <li>• ACGIH TLVs</li> <li>• Other recommended limits</li> </ul>
Physical/Chemical Characteristics	<ul style="list-style-type: none"> <li>• Boiling point</li> <li>• Vapor pressure and density</li> <li>• Solubility in water</li> <li>• Appearance and odor</li> <li>• Evaporation rate</li> <li>• Melting point</li> </ul>
Fire and Explosion Hazard Data	<ul style="list-style-type: none"> <li>• Fire and explosion hazard data</li> <li>• Flash point</li> <li>• Flammable limits</li> <li>• Extinguishing media</li> <li>• Special firefighting procedures</li> <li>• Physical hazards</li> </ul>
Reactivity Data	<ul style="list-style-type: none"> <li>• Stability of the substance</li> <li>• Conditions to avoid</li> <li>• Incompatibility with other materials</li> <li>• Hazardous decomposition properties</li> <li>• Associated by-products</li> </ul>
Health Hazard Data	<ul style="list-style-type: none"> <li>• Acute (short-term) health hazards</li> <li>• Chronic (long-term) health hazards</li> <li>• Routes of entry</li> <li>• Target organs</li> <li>• Carcinogenicity (cancer-causing)</li> <li>• Signs and symptoms of exposure</li> <li>• Medical conditions aggravated</li> <li>• Emergency first aid procedures</li> </ul>
Precautions for Safe Handling and Use	<ul style="list-style-type: none"> <li>• Precautions for safe handling</li> <li>• Precautions for safe use</li> <li>• Spill containment procedures</li> <li>• Waste disposal methods</li> <li>• Precautions for storage</li> </ul>
Control Measures	<ul style="list-style-type: none"> <li>• Exposure control measures</li> <li>• Engineering controls</li> <li>• Administrative controls</li> <li>• Work practices</li> <li>• Personal protective equipment</li> </ul>



# WD-40®



## MATERIAL SAFETY DATA SHEET

### I. PRODUCT IDENTIFICATION

Manufacturer:	WD-40 Company	Telephone:	
Address:	1061 Cudahy Place (92110) P.O. Box 80607 San Diego, California 92138-0607	Emergency Only:	1 (800) 424-9300 (CHEMTREC) (619) 275-1400
		Chemical Name:	Organic Mixture
		Trade Name:	WD-40 Aerosol
		Item No.	10002, 10005, 10008, 10011, 10013, 10016, 10023

### II. HAZARDOUS INGREDIENTS

Chemical Name	CAS Number	%	Exposure Limit ACGIH/OSHA
Aliphatic Petroleum Distillates	8052-41-3	60-70	100 ppm PEL
Petroleum Base Oil	64742-65-0	15-25	5 mg/M <sup>3</sup> TWA (mist)
Carbon Dioxide	124-38-9	2-3	5000 ppm PEL
Non-hazardous Ingredients		<10	

### III. PHYSICAL DATA

Boiling Point:	NA	Evaporation Rate:	Not determined
Vapor Density (air = 1):	Greater than 1	Vapor Pressure:	110 ±5 PSI @ 70°F
Solubility in Water:	Insoluble	Appearance:	Light amber
Specific Gravity (H <sub>2</sub> O = 1):	0.816 @ 70°F	Odor:	Characteristic odor
Percent Volatile (volume):	70%		

### IV. FIRE AND EXPLOSION

Flash Point:	Tag Open Cup 110°F (minimum)
Flammable Limits:	(Solvent Portion) [Le] 1.0% [Uel] 6.0%
Extinguishing Media:	CO <sub>2</sub> , Dry Chemical, Foam
Special Fire Fighting Procedures:	Contents Under Pressure
Unusual Fire and Explosion Hazards:	FLAMMABLE – U.F.C. level 3 AEROSOL

### V. HEALTH HAZARD / ROUTE(S) OF ENTRY

<b>Threshold Limit Value</b> Aliphatic Petroleum Distillates (Stoddard solvent) lowest TLV (ACGIH 100 ppm.)	
<b>Symptoms of Overexposure</b>	
<b>Inhalation (Breathing):</b>	May cause anesthesia, headache, dizziness, nausea and upper respiratory irritation.
<b>Skin Contact:</b>	May cause drying of skin and/or irritation.
<b>Eye Contact:</b>	May cause irritation, tearing and redness.
<b>Ingestion (Swallowed):</b>	May cause irritation, nausea, vomiting and diarrhea.
<b>First Aid Emergency Procedures</b>	
<b>Ingestion (Swallowed):</b>	Do not induce vomiting, seek medical attention.
<b>Eye Contact:</b>	Immediately flush eyes with large amounts of water for 15 minutes.
<b>Skin Contact:</b>	Wash with soap and water.
<b>Inhalation (Breathing):</b>	Remove to fresh air. Give artificial respiration if necessary. If breathing is difficult, give oxygen.
	Pre-existing medical conditions such as eye, skin and respiratory disorders may be aggravated by exposure.
<b>DANGER!</b>	
<b>Aspiration Hazard:</b>	If swallowed, can enter lungs and may cause chemical pneumonitis. Do not induce vomiting. Call Physician immediately.
<b>Suspected Cancer Agent</b>	
Yes _____ No <u>  X  </u>	The components in this mixture have been found to be noncarcinogenic by NTP, IARC and OSHA.

Figure 2-5. Manufacturer's MSDS for WD-40. (Courtesy of WD-40 Company)

**VI. REACTIVITY DATA**

Stability:	Stable <u>  x  </u>	Unstable <u>      </u>
Conditions to avoid:	NA	
Incompatibility:	Strong oxidizing materials	
Hazardous decomposition products:	Thermal decomposition may yield carbon monoxide and/or carbon dioxide.	
Hazardous polymerization:	May occur <u>      </u>	Will not occur <u>  x  </u>

**VII. SPILL OR LEAK PROCEDURES****Spill Response Procedures**

Spill unlikely from aerosol cans. Leaking cans should be placed in plastic bag or open pail until pressure has dissipated.

**Waste Disposal Method**

Empty aerosol cans should not be punctured or incinerated; bury in land fill. Liquid should be incinerated or buried in land fill. Dispose of in accordance with local, state and federal regulations.

**VIII. SPECIAL HANDLING INFORMATION**

Ventilation:	Sufficient to keep solvent vapor less than TLV.
Respiratory Protection:	Advised when concentrations exceed TLV.
Protective Gloves:	Advised to prevent possible skin irritation.
Eye Protection:	Approved eye protection to safeguard against potential eye contact, irritation or injury.
Other Protective Equipment:	None required.

**IX. SPECIAL PRECAUTIONS**

Keep from sources of ignition. Avoid excessive inhalation of spray particles, do not take internally. Do not puncture, incinerate or store container above 120°F. Exposure to heat may cause bursting. Keep can away from electrical current or battery terminals. Electrical arcing can cause burn-through (puncture) which may result in flash fire, causing serious injury. Keep from children.

**X. TRANSPORTATION DATA (49 CFR 172.101)****Domestic Surface**

Description:	Consumer Commodity
Hazard Class:	ORM-D
ID No.:	NONE
Label Required:	Consumer Commodity (ORM-D)

**Domestic Air**

Description:	Consumer Commodity (Non-Flammable Gas – Aerosol)
Hazard Class:	ORM-D
ID No.:	NONE
Label Required:	Consumer Commodity (ORM-D-AIR)

**XI. REGULATORY INFORMATION**

All ingredients for this product are listed on the TSCA inventory.

SARA Title III chemicals:	None
California Prop 65 chemicals:	None
CERCLA reportable quantity:	None
RCRA hazardous waste no.:	D001 (Ignitable)

SIGNATURE:  TITLE: Technical Director

REVISION DATE: March 1998 SUPERSEDES: June 1996

NA = Not applicable      NDA = No data available      < = Less than      > = More than

We believe the statements, technical information and recommendations contained herein are reliable. However, the data is provided without warranty, expressed or implied. It is the user's responsibility both to determine safe conditions for use of this product and assume loss, damage or expense, direct or consequential, arising from its use. Before using product, read label.

MSDS-A

**Figure 2-5.** Manufacturer's MSDS for WD-40. (Courtesy of WD-40 Company)

**HAZARDOUS  
CHEMICAL LABELS  
AND LISTS**

Under OSHA regulations, manufacturers, importers, and distributors of hazardous chemicals must label all products with information that identifies the specific hazards of the products. Employers may not remove these labels. If an employer transfers hazardous material into another container to be used by another employee for longer than one shift, the new container must also be labeled. Figure 2-6 shows two examples of product labels. Labels must include:

- Product name.
- Name, address, and phone number of the manufacturer, importer, or supplier.
- Hazards of the product including information such as:
  - Precautionary warning words, such as caution or warning.
  - Reactivity hazards of the product. For example, can the product be safely mixed with water?
  - Health hazards of the product, such as cancer-causing or respiratory irritant.
  - Target organs that might be affected by exposure, such as the lungs or kidneys.
  - Measures to protect the user, such as adequate ventilation or protective clothing.
  - Emergency first-aid information. For example, wash exposed areas with water for 15 minutes.

Information might be presented on the container in the form of a sign, symbol, or written word. Important warning words frequently used on labels include:

- Caution – Use with care. Workers are at some risk.
- Warning – The product presents more risk than one with a caution label.
- Danger – The most severe rating. The product presents a serious potential threat.

<div style="font-size: 100px; font-weight: bold; margin: 0;">F</div> <p style="font-size: 0.8em; margin: 5px 0;">For laboratory and manufacturing use only, not for drug, food, or household use.</p> <p style="font-weight: bold; margin: 0;">Class 1B 4L</p> <p style="font-size: 1.5em; font-weight: bold; margin: 0;">S77798</p> <p style="margin: 0;">Isopropanol UN1219</p> <div style="display: flex; align-items: center; margin-top: 10px;"> <div> <p style="font-weight: bold; margin: 0;">FisherScientific®</p> </div> </div>	<h2 style="margin: 0;">2 - Propanol</h2> <p style="font-weight: bold; margin: 5px 0;">WARNINGS!</p> <p style="font-size: 0.8em; margin: 0;">FLAMMABLE FLASH POINT...59°F. HARMFUL IF INHALED. 20,000 ppm, IMMEDIATELY DANGEROUS TO LIFE AND HEALTH. CAUSES IRRITATION TO EYES, SKIN, AND MUCOUS MEMBRANES. IRRITANT AND ANESTHETIC. HARMFUL IF SWALLOWED. OVEREXPOSURE MAY CAUSE NARCOSIS, DEPRESSED RESPIRATION, ANEMIA, UREMIA, COMA, AND DEATH FROM RESPIRATORY PARALYSIS.</p> <p style="font-size: 0.8em; margin: 0;">TARGET ORGANS AFFECTED: Eyes, mucous membranes, skin, respiratory and central nervous systems. Do not breathe vapors. Keep container closed. Use only with adequate ventilation by providing local exhaust or process enclosure to meet permissible exposure limits or use NIOSH recommended respirators listed in the Material Safety Data Sheet. Keep away from heat, sparks, and open flame. Wash thoroughly after handling. Do not take internally. <b>FIRST AID - INHALATION</b> - Remove from exposure area to fresh air immediately.</p>	<p style="font-weight: bold; margin: 0;">Fisher Chem AL Guide</p> <p style="font-weight: bold; margin: 5px 0;">SAFETY CODE</p> <div style="display: flex; align-items: center; margin: 5px 0;"> <div> <p style="font-size: 0.8em; margin: 0;">Goggles</p> <p style="font-size: 0.8em; margin: 0;">Gloves</p> <p style="font-size: 0.8em; margin: 0;">Apron</p> </div> </div> <p style="font-weight: bold; margin: 5px 0;">NFPA CODE</p> <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px 5px;">1</div> <div style="border: 1px solid black; padding: 2px 5px;">4</div> <div style="border: 1px solid black; padding: 2px 5px;">1</div> </div> </div>
	<p style="font-size: 0.8em; margin: 0;">711 Forbes Avenue Pittsburg, PA 15219-4785 (412) 562-8300</p>	

ACETONITRILE

CAS NO. 75-05-08 NA-1648 RQ

WARNING!

FLAMMABLE

MAY BE HARMFUL OR FATAL IF SWALLOWED, INHALED, OR ABSORBED THROUGH THE SKIN.

MAY BE IRRITATING TO THE SKIN, EYES, AND RESPIRATORY TRACT.

TOXIC EFFECTS MAY BE DELAYED.

Before using this product, read the MSDS which contains more detailed precautionary measures, handling instructions, and emergency procedures.

Keep away from heat, sparks, and flame. Avoid breathing vapor. Use with adequate ventilation. Avoid contact with eyes, skin, and clothing. If contact is unavoidable, wear protective clothing, face protection, and gloves. Wash thoroughly after handling and before eating, drinking, or smoking. Keep container closed.

**FIRST AID:**

<b>If swallowed/victim is conscious:</b>	Give 1-3 glasses of water or milk and INDUCE VOMITING. Do not induce vomiting with a semi-conscious or unconscious person. GET IMMEDIATE MEDICAL ATTENTION.
<b>If in eyes:</b>	Flush immediately with plenty of water for at least 15 minutes. Eyelid should be held away from the eye to ensure thorough rinsing. Get medical attention if irritation persists.
<b>If on skin:</b>	Wash exposed area thoroughly with soap and water. Remove contaminated clothing and shoes. Wash clothing and thoroughly clean shoes before reuse. GET MEDICAL ATTENTION.
<b>If inhaled:</b>	Remove affected person from the source of exposure. If not breathing, administer CPR. If breathing is difficult, ensure a clear airway and oxygen may be given. GET IMMEDIATE MEDICAL ATTENTION.

Standard Oil Chemical Company  
(216) 586-4141  
Cleveland, Ohio, 44114-2375, U.S.A.

**Figure 2-6.** Examples of two product labels.

**Special Labels**

Although special labels are not required by the standard, employers may use them when hazardous chemicals are transferred from larger to smaller containers on the job site. These labels must not be removed or defaced because they provide important information. Figure 2-7 shows a typical label used for identifying hazardous materials with the Hazardous Materials Identification System (*HMIS*). The name of the product is listed and the appropriate boxes are marked under the headings:

- Target organs and effects
- Health hazards
- Physical hazards
- Route of entry

The label in Figure 2-7 has circles in front of health, flammability, reactivity, and protective equipment. These circles are filled in with a letter or number from the lists in the figure. Information from MSDSs, product labels, and Department of Transportation (*DOT*) or National Fire Protection Association (*NFPA*) labels are also used to fill out these special labels.



































There may be other labels on a hazardous chemical container providing hazard information. The two most common labels are from the NFPA and the DOT.

<b>NAME OF PRODUCT</b> <u>2 - Propanol</u>	
<b>CHECK APPROPRIATE BOXES</b> <b>TARGET ORGANS &amp; EFFECTS</b> <input type="checkbox"/> Lungs <input type="checkbox"/> Liver <input type="checkbox"/> Kidney <input type="checkbox"/> Blood <input checked="" type="checkbox"/> Skin, Eyes <input type="checkbox"/> Heart <input type="checkbox"/> Cardiovascular System <input checked="" type="checkbox"/> Central Nervous System <input checked="" type="checkbox"/> Respiratory System <b>HEALTH HAZARDS</b> <input type="checkbox"/> Toxic <input type="checkbox"/> Corrosive <input type="checkbox"/> Highly Toxic <input type="checkbox"/> Sensitizer <input checked="" type="checkbox"/> Irritant <input type="checkbox"/> Carcinogen <input type="checkbox"/> Reproductive Toxin <input type="checkbox"/> None <b>PHYSICALS HAZARDS</b> <input type="checkbox"/> Compressed Gas <input type="checkbox"/> Explosive <input type="checkbox"/> Combustible Liquid <input type="checkbox"/> Organic Peroxide <input type="checkbox"/> Oxidizer <input type="checkbox"/> Reactive <input checked="" type="checkbox"/> Flammable Liquid/Solid <input type="checkbox"/> Flammable Gas <b>ROUTE OF ENTRY</b> <input checked="" type="checkbox"/> Inhalation <input type="checkbox"/> Ingestion <input checked="" type="checkbox"/> Absorption (skin or eye contact)	<div>① HEALTH</div> <div>④ FLAMMABILITY</div> <div>① REACTIVITY</div> <div>Ⓜ PROTECTIVE EQUIPMENT</div>











**Hazard Level**

- 4 Severe Hazard  
 3 Serious Hazard  
 2 Moderate Hazard  
 1 Slight Hazard  
 0 Minimal Hazard

**Personal Protection Index**

<b>A</b>		
<b>B</b>	 + 	
<b>C</b>	 +  + 	
<b>D</b>	 +  + 	
<b>E</b>	 +  + 	
<b>F</b>	 +  +  + 	
<b>G</b>	 +  + 	
<b>H</b>	 +  +  + 	
<b>I</b>	 +  + 	
<b>J</b>	 +  +  + 	
<b>K</b>	 +  +  + 	
<b>X</b>	ASK YOUR SUPERVISOR FOR SPECIALIZED HANDLING DIRECTIONS	

**Key**

	Safety Glasses
	Splash Goggles
	Face Shield
	Supplied Air Respirator
	Chemical Resistant Gloves
	Chemical Resistant Apron
	Dust Air Purifying Respirator
	Vapor Air Purifying Respirator
	Combination Dust Vapor Air Purifying Respirator
	Full Chemical Resistant Suit
	Chemical Resistant Boots

**Figure 2-7.** An example of an HMIS label with hazard and personal protection explanations.

**National Fire  
Protection Association  
Labels**

The NFPA label is a hazard system identification label developed to warn firefighters about potential chemical hazards in a fire. It's commonly used today and provides important information to the worker.

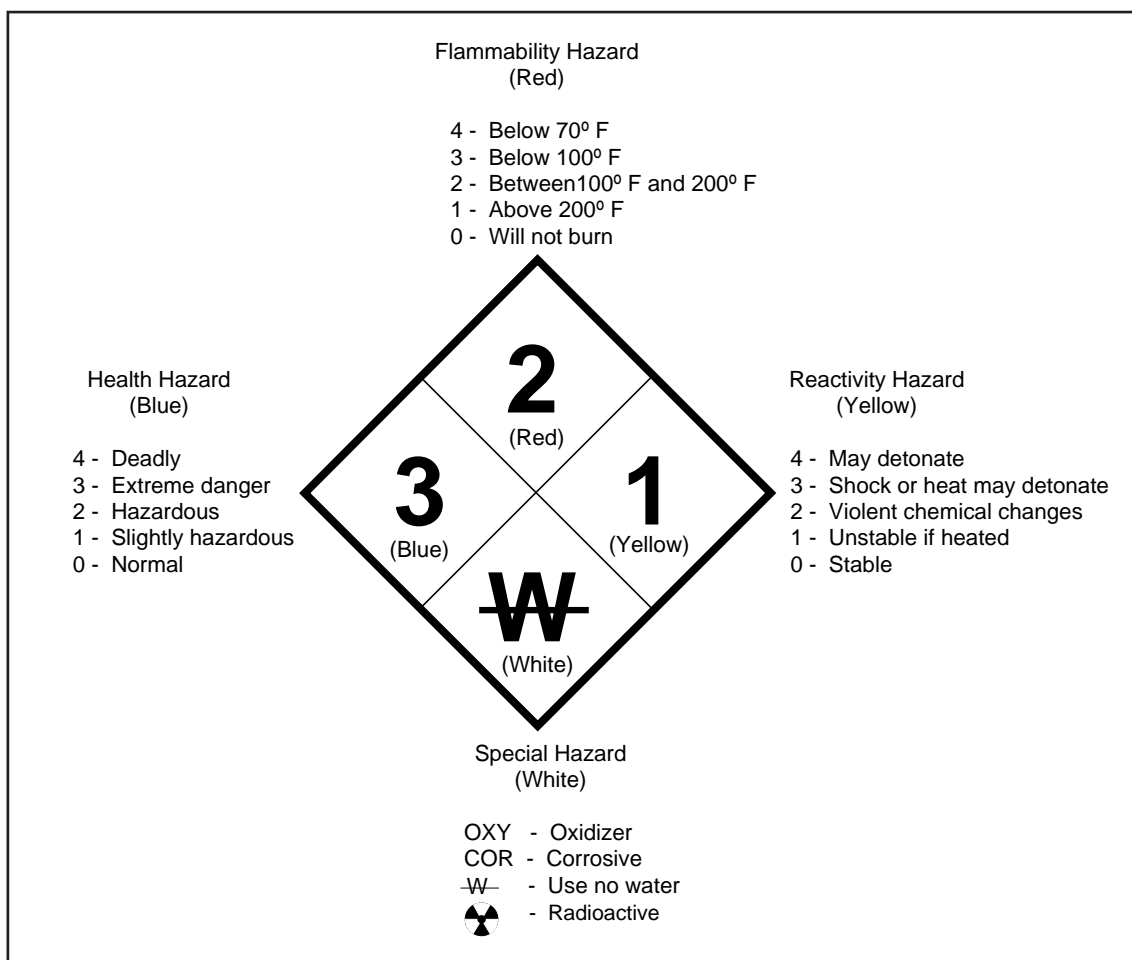
The NFPA label is a diamond containing four squares in different colors. The squares are red, blue, yellow, and white. The red, blue, and yellow squares contain a hazard rating, ranging from 0 to 4, that indicates the severity of the hazard. The white square is reserved for symbols representing special hazards.

Figure 2-8 shows an example of an NFPA label and identifies the following:

- Color code designations
- Hazard ratings meanings
- Special hazard symbols

Table 2-2 is a more detailed explanation of the NFPA color codes and hazard rating information.

**Note:** An NFPA label does not cover chronic health effects. In addition, the names of the chemical, the product, and the manufacturer are not given.



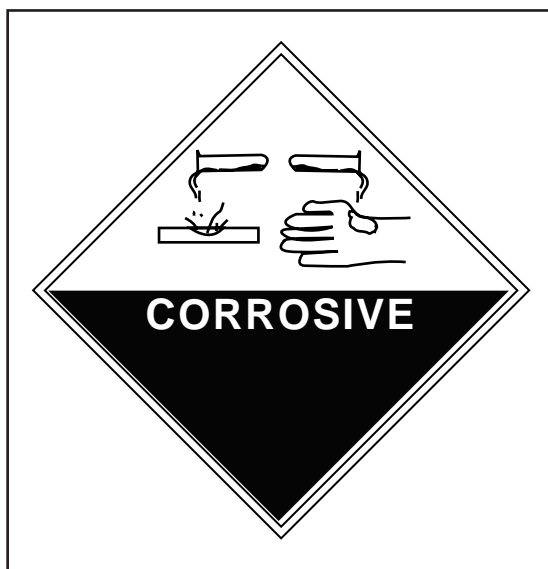
**Figure 2-8.** Sample NFPA label with color codes and hazard information.

**Table 2-2.** NFPA color codes and hazard rating information

<b>Health Hazard</b> Color Code: <b>BLUE</b>  Health hazards are noted in the blue square and are rated from 0 to 4, with 4 as the most dangerous level.  Type of Possible Injury		<b>Flammability Hazard</b> Color Code: <b>Red</b>  Fire hazards are noted in the red square and are rated from 0 to 4, with 4 as the most dangerous level.  Susceptibility of Materials to Burn		<b>Reactivity Hazard</b> Color Code: <b>Yellow</b>  Explosion hazards are noted in the yellow square and are rated from 0 to 4, with 4 as the most dangerous level.  Susceptibility to Release of Energy	
4	Extremely Hazardous (deadly) - very short exposure can cause death or major long-term injury.	4	Extremely Flammable (below 73°F) - turns into a gas rapidly under normal conditions and burns easily.	4	Extremely Unstable (may detonate) - under normal conditions, this chemical may explode or react violently.
3	Highly Hazardous (extreme danger) - short exposure can cause serious temporary or possible long-term injury.	3	Highly Flammable (below 100°F) - liquid or solid can be ignited at almost any ordinary temperature.	3	Unstable (shock or heat may detonate or explode) - may react with water, or may need heating or another strong initiating source.
2	Moderately Hazardous (hazardous) - intense or continued exposure can cause temporary or possible long-term injury.	2	Moderately Combustible (between 100°F and 200°F) - must be heated somewhat or be in a very hot place before ignition can occur.	2	Unstable (violent chemical changes) - may react violently with water, or undergo violent chemical changes without exploding.
1	Slightly Hazardous (slightly hazardous) - exposure can cause irritation but only minor injury.	1	Slightly Combustible (above 200°F) - must be heated before ignition can occur.	1	Unstable if Heated - normally stable, but can become unstable when hot or under pressure. Reactions with water are not violent.
0	No Health Hazard (normal) - exposure under fire conditions would offer no hazard beyond that of ordinary combustibles.	0	Nonflammable or Noncombustible - will not burn.	0	Stable - normally stable, even in fire. Does not react with water.

**Department of  
Transportation Labels**

The DOT label is used on containers and cartons of hazardous materials or products that are shipped across state lines. These labels are in addition to those required by OSHA regulations. A DOT label contains three types of information: color, hazard word, and hazard symbol. Figure 2-9 shows the DOT label for a corrosive chemical. The combination of color, hazard word and hazard symbol gives a great deal of information about the hazardous material. However, the DOT label does not identify the product's name, manufacturer, or chemical contents.



**Figure 2-9.** A DOT label for a corrosive chemical.

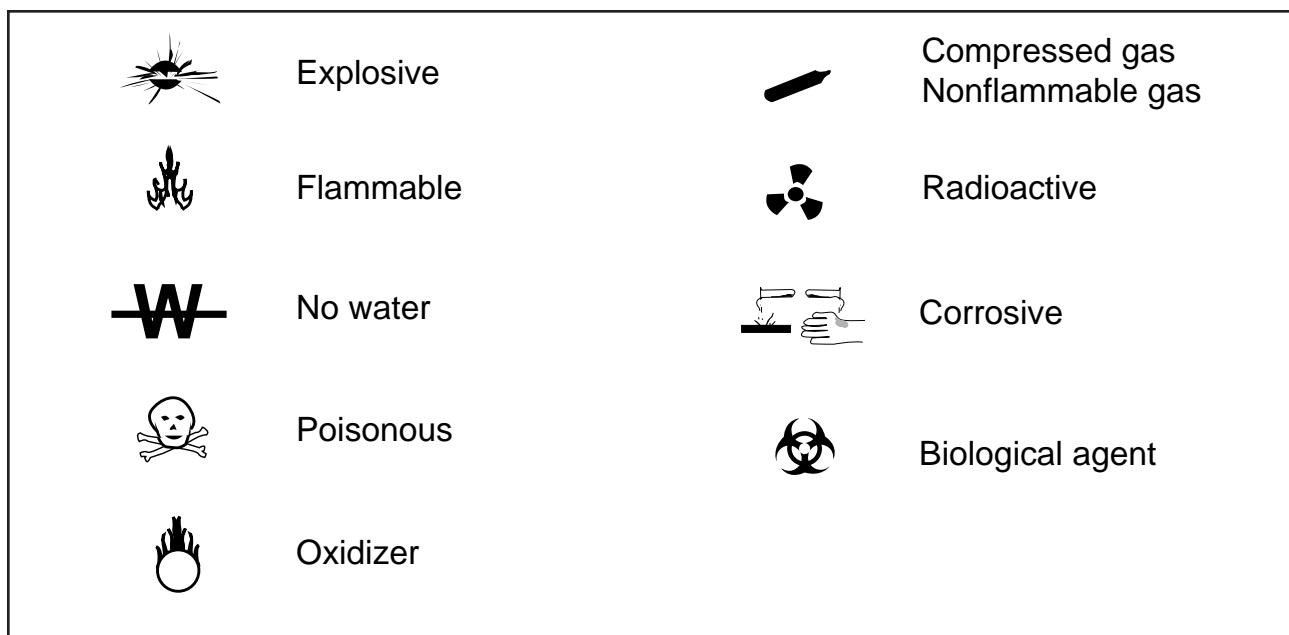
Table 2-3 lists the color-coded backgrounds and hazard words used on DOT labels. Figure 2-10 shows the different hazard symbols used on the label.

When shipping hazardous materials, the severity of a hazard may be indicated on the shipping container. Hazards are divided into three packing groups:

- Packing Group I – Great Danger
- Packing Group II – Medium Danger
- Packing Group III – Minor Danger

**Table 2-3 .** Color-coded backgrounds and hazard words found on DOT labels

Color Codes	Hazard Words
Orange	Explosive Blasting agent
Red	Flammable Combustible
Green	Nonflammable
Yellow	Oxidizer Oxygen Organic peroxide
White with red stripes	Flammable solids
Yellow and white	Radioactive
White and black	Corrosive
White	Poison Chlorine
Blue	Dangerous when wet
Special	Biological agent

**Figure 2-10.** Examples of hazard symbols used on a DOT label

**CHEMICALS USED IN CONSTRUCTION**

There are many hazardous chemicals used in construction that workers may be exposed to. Most of these chemicals are grouped into general categories of similar hazards. The most common categories of hazardous chemicals found on construction sites include:

- Acids, bases, and alkalis
- Adhesives and sealants
- Cleaners
- Concrete
- Fuels
- Solvents
- Wood

**Acids, Bases, and Alkalis**

Acids and bases (caustics) come in various forms—gases, liquids, and solids. Examples of common acids include sulfuric acid, hydrochloric acid, muriatic acid, and nitric acid. Commonly used bases (caustics) are lye (sodium hydroxide) and potash (potassium hydroxide). Both acids and bases can easily damage the skin and eyes. The seriousness of the damage depends on the strength of the chemical, length of contact, and actions taken.

Both acids and bases can be corrosive and can damage whatever material they touch. The more concentrated the chemical, the more dangerous it can be. Vinegar is a mild form of acetic acid and can be swallowed or rubbed on the skin with no damage. However, a concentrated solution of acetic acid causes serious burns.

Different acids react differently when they contact skin. Below are some examples:

- Mixing sulfuric acid with water produces heat. If sulfuric acid contacts skin, it reacts with the skin's moisture and burns.
- If hydrofluoric acid spills on the skin, a worker may not notice it. But hours later, the hydrofluoric acid will have worked its way through the skin and into the muscle tissue, causing deep burns. These burns are painful and take a long time to heal. If serious enough, they can cause death.

- Acids can damage the respiratory system when inhaled. Some acids in a gas or vapor form react with the moisture in the nose and throat causing irritation or tissue damage. Acetic and nitric acid vapors quickly penetrate the lungs causing serious damage.

In general, bases feel slippery or soapy. Soap is made from a mixture of a base (lye) and animal fat.

Concentrated bases dissolve tissue easily and can cause severe skin damage on contact. Concentrated caustic gases, like ammonia, can damage the skin, eyes, nose, mouth, and lungs. Even dry powder forms of bases can cause damage when absorbed or inhaled, because they react with the moisture in the skin, eyes, and respiratory tract.

Always follow these rules when working with acids and bases:

- Know what chemicals are being worked with and how strong or concentrated they are.
- Use personal protective equipment, as required.
- In case of skin or eye contact, flush with cool water for at least 15 minutes. Do not rub skin or eyes.
- When mixing acids and water, always add the acid to the water to prevent splatter.
- Keep acids and bases apart. Store them separately and cleanup spills promptly. Acid and bases react, often violently, when mixed.

Cement and mortar are alkali compounds in their wet or dry form. As dust and powder, they can damage the skin and eyes when they react with moisture in the body. Cement and mortar also can cause allergic reactions in people who become sensitive to them.

**Adhesives and Sealants**

All adhesives and sealants have some type of hazard warning on the label. Because people often use them at home and on the job, warnings are taken lightly or ignored. However, adhesives and sealants are toxic because of their chemically reactive ingredients, or because of the solvent base that permits them to be applied more easily.

Adhesives or sealants that contain solvents may be flammable. Other types of adhesives, such as caulking or wood glue, may irritate eyes and skin. When working with any glue, avoid eye and skin contact. If the label says the adhesive is flammable, use and store it away from sources of ignition.

Epoxies contain epoxy amine resins and polyamide hardeners, each of which sensitizes skin and irritates the respiratory tract. Overexposure to epoxies can cause dizziness, drowsiness, nausea, and vomiting. Extreme or prolonged exposure can damage the kidneys and liver.

Flooring adhesives may contain acrylics that irritate the skin and cause nausea, vomiting, headache, weakness, asphyxia, and death. Other adhesives or sealants contain coal tar derivatives that are suspected of causing cancer. Avoid prolonged breathing of vapors or skin contact.

**Cleaners**

Cleaners contain acids, alkalis, aromatics, surfactants, petroleum products, ammonia, and hypochlorite. These ingredients cause cleaners to be irritating, and they can be harmful if swallowed or inhaled. Hazards from cleaners include:

- Health hazards (eye, nose, throat, skin, and lung irritation)
- Fire (some cleaners burn easily)
- Corrosive (cause severe skin damage)

Because of the variety of cleaning materials in use, there are many signs and symptoms of overexposure. Therefore, it is important for workers to read a product's MSDS to learn its specific signs and symptoms.

Many industrial cleaners are products commonly found in the home, so workers may underestimate the hazards they pose. Workers can protect themselves from these chemicals by taking the following actions:

- Read the labels and follow recommended precautions.
- Wear gloves and eye protection.
- Wash hands and face thoroughly before eating, drinking, or smoking.
- Do not inhale vapors or mists.
- Do not eat, drink, or smoke where vapors, mists, or dust are in the air.

Do not mix cleaning chemicals together unless specifically told to do so by a technical expert. Some chemicals can become deadly when mixed. For example, when bleach and ammonia or bleach and a drain cleaner are mixed, chlorine gas is produced. Chlorine gas is toxic and potentially explosive.

## **Concrete**

Cement and lime, components of concrete, can cause adverse health effects such as skin irritation. The more lime in the cement, the more irritating it is to the skin. Cement that is even slightly moist can cause the skin to become hard, dry, and thick. The skin often cracks and can form ulcers. When water is added to cement, it produces heat which can also irritate and burn the skin. Cement dust also irritates the eyes, nose, and mouth. Use proper personal hygiene and the appropriate PPE to protect against cement's irritating alkaline effects.

Once concrete has cured or hardened, the health hazard to workers is dust which can damage the respiratory system. The dust is created when cutting concrete. Always try to use water to control the generation of dust. Also wear the appropriate respiratory protection to protect the lungs from the dust.

**Fuels**

The primary hazard posed by fuels is fire. Fuels are either flammable or combustible and should be handled with care. Follow these steps when handling fuel:

- Know the location of fire extinguishers, fire alarms, and evacuation procedures when dispensing or using fuels.
- Always store and transport fuel in approved, self-closing safety containers.
- Store gasoline and kerosene in properly marked containers. Never use kerosene containers for the transport or storage of gasoline.
- When filling portable containers with flammable materials, properly ground and bond the container to prevent ignition caused by static electricity.
- Use a bonding clamp to bond and ground containers when dispensing fuels.
- Check that spark-arrestors are in place when using portable containers.
- Remember, if a fuel is spilled, the vapors can travel some distance to an ignition source resulting in fire or an explosion.
- Do **not** store, use, or dispense fuel near arc welding or open flames.
- Do **not** pour waste fuel and flammable liquids down drains. See the MSDS for proper disposal procedures.

Excessive skin contact with fuels results in dermatitis. Fuels can enter the body through the skin, and over a long period, break down the fatty tissues and possibly build up in the body. Excessive inhalation of fuels may cause central nervous system depression and aggravate any existing respiratory disease. Leukemia, a blood disorder that usually causes death, is a potential side effect of chronic (long-term) exposure to fuels. Ingestion of fuels may cause poisoning and possible lung damage if aspirated into the lungs when ingested. Acute exposure to fuels may result in skin, lung, and respiratory tract irritation.

Workers can protect themselves from these chemicals by reading the labels and following the recommended precautions. Wear gloves and eye protection and avoid inhaling the vapors and mists. Wash hands and face thoroughly before eating, drinking, or smoking. Specific emergency first-aid procedures are given in the MSDS for fuels. In general, if fuel gets into the eyes, flush with clean running water for at least 15 minutes and then seek medical attention. If it gets on the skin, wash the area of contact.

## Solvents

A solvent is a substance, usually a liquid, that can dissolve another substance. In construction, the most commonly used solvents are cleaners, degreasers, and thinners. There are two main classes of solvents:

1. Aqueous solvents (water-based), such as acids, alkalis, and detergents.
2. Organic solvents (carbon-containing), such as acetone, benzene, mineral spirits, toluene, trichloroethylene, and turpentine.

The two most common ways solvents enter the body are inhalation (breathing) or absorption (skin contact). Exposure to water based solvents results in health effects such as dermatitis and irritation. Excessive exposure to aqueous solvents in the form of mists can cause throat irritation or bronchitis.

Organic solvents cause more serious health effects, depending on the solvent and the exposure level. All organic solvents affect the central nervous system by acting as depressants or anesthetics. Effects can range from dizziness and headaches to respiratory arrest and death. Workers exposed to organic solvents can also experience:

- Nose, throat, eye, and lung irritation
- Damage to the liver, blood, kidneys, and digestive system

Upon contact with the skin, an organic solvent will dissolve the oils in the skin. The skin becomes dry and irritated, producing cracking, and skin rashes. Once a solvent penetrates the skin, it enters the bloodstream and can attack the central nervous system and other body organs. Like all chemicals, the effect a solvent has upon a worker depends on several factors:

- The chemical's toxicity
- Length of exposure
- The body's sensitivity level
- Solvent's concentration

Workers can protect themselves from solvent hazards by following these simple rules:

- Know what chemicals are being used.
- Wear appropriate PPE, such as gloves, safety glasses, and respirators to prevent contact with the skin, eyes, and lungs.
- Ensure the work area has plenty of fresh air.
- Avoid skin contact with solvents.
- Wash with plenty of soap and water if skin contacts the solvent.
- If a solvent splashes into the eye, flush with running water for at least 15 minutes and get medical help.

## Wood

The primary concern regarding wood is pressure-treated lumber. The pressure treatment process uses inorganic arsenic, copper, zinc, a pesticide, or a combination of these, sometimes called *CCA (chromated copper arsenate)* to protect the lumber from decay and insect attack. The chemicals are forced deeply into the wood where they remain for a long time. As a result, treated wood, whether fresh from the lumber yard or found in an existing structure, can pose health hazards if not handled properly.

Avoid inhalation of sawdust from treated wood. Wear a dust mask when cutting, routing, sanding, or working with treated wood. Whenever possible, perform these operations outdoors to avoid indoor accumulations of airborne sawdust from treated wood. Keep bystanders, children, and pets from walking in the collected sawdust.

Some treated woods may appear damp and have chemical residue on the surface. Use gloves when handling freshly treated lumber and especially the sawdust from freshly treated wood.

Clean up all wood construction debris and dispose in ordinary trash collection. Do not burn pressure treated scraps in home stoves, fireplaces, or open fires, because the chemicals may become part of the smoke and ashes. Treated wood may be burned in commercial and industrial incinerators or boilers, according to state and federal regulations. Do not use treated wood in circumstances where the wood will come in direct contact with food or with public drinking water sources.

Acute allergic reactions have been reported following contact with mahogany, birch, beech, and other untreated woods. These reactions include hives, respiratory tract irritation, and general swelling. To reduce the likelihood of such a reaction, use good personal hygiene. Wash hands and face thoroughly. Take meals and breaks away from the work area. Upon completion of work, remove work clothing and launder separately from non-work clothing. Shower thoroughly to remove any material in contact with skin.

### **TYPICAL CONSTRUCTION HAZARDS**

Table 2-4 provides a review of the typical hazardous substances used in construction. Hazardous substances are arranged by classes with information on each class summarized in the table. The table covers the following areas:

- Class – group of similar substances used for the same purpose, such as abrasives or fuels.
- Examples – identifies examples of the commonly used substances in each class.

- Routes of Entry – identifies how a particular substance enters the body. Routes of entry include:
  - Inhalation (breathing)
  - Ingestion (swallowing)
  - Absorption (skin)
  - Skin or eye contact
- Physical Hazards – describes the hazards a substance holds for workers, such as explosive, flammable, or compressed gas.
- Health Hazards – explains the health effects a substance may have if workers are exposed to it. Examples include irritating to skin, cancer-causing and infectious.
- Target Organs – identifies which organs in the body are affected by exposure to the hazardous substance.
- How Detected – a general guide as to how workers might recognize this group of substances. For example, fuels are usually liquids that have a characteristic odor that is easily recognized.
- Types of Protection – provides some general guidelines for workers on protecting themselves from exposure, such as respirators and ventilation to protect the lungs. It notes when a substance can be transferred from the air or hands to food, drink, or smoking materials.

Use this table as a general review of hazardous chemical information. **Always** review the MSDSs for hazardous chemicals used on the job site, especially when a chemical is used for the first time. The MSDS may differ from the information in the table. Follow the MSDS.

There are many hazardous chemicals used in construction. Other construction trades are exposed to a few of these chemicals. However, construction laborers may be exposed to all of them.

**Table 2-4.** This table lists hazardous substances used in construction.

Class	Examples	Entry Routes	Physical Hazards	Health Hazards	Target Organs	How Detected	Types of Protection
Abrasives	Abrasive belts, disks, and wheels; silica, sandblasting	Inhalation, Skin and eye contact	Physical injury to skin and eyes	Damage to skin, eyes, and lungs. Chronic lung disease. Cancer, if removing nickel or chrome alloy metals or asbestos coatings.	Skin, eyes, lungs	Airborne dust	Ventilation, respirators, eye protection, face shields, gloves
Adhesives	Caulking, epoxy, plastic cement, flooring adhesives, super glue, urethane sealant, white glue	Inhalation Ingestion Skin and eye contact	Combustible Flammable	Damage to skin, eyes, and lungs. Skin sensitizers. Nervous system effects. Mucous membrane irritant. Cancer, toxic.	Lungs, kidneys, liver, eyes, skin, central nervous system, peripheral nervous system	Odor. Container. Usually liquids.	Ventilation, respirators, eye protection, gloves, personal hygiene
Asbestos	Insulation on pipe, beams, ceilings, etc.	Inhalation	None	Damage to lungs. Cancer.	Lungs	Unknown. Insulation, usually old and friable.	Training required by OSHA regulations. Contact a foreman if you suspect asbestos is present.
Asphalt products	Asphalt, tar, creosote, cutback, pitch	Inhalation Ingestion Skin and eye contact	Combustible Flammable	Damage to skin, eyes, and lungs. Cancer. Irritant. Toxic.	Lungs, liver, kidneys, eyes, skin, brain, bladder, central nervous system	Odor. Fumes. May be hot. Solid or liquid.	Ventilation, respirators. eye protection, gloves, personal hygiene, coveralls
Biological materials	Sewage, fecal matter, tetanus, rabies	Inhalation Ingestion Skin contact	None	Localized skin infections. Infectious diseases.	Skin, body in general depending upon the specific disease.	Work area. Animals when site cleaning.	Personal hygiene, gloves, respirators, tetanus immunization
Cleaners	Bleach, drain and glass cleaner, germicide, metal polish, stain removers, cleaning sprays	Inhalation Ingestion Skin and eye contact	Flammable Reactive	Irritant to eyes, nose, throat, skin, and lungs. Corrosive. Damage to skin, eyes, and lungs.	Skin, eyes, lungs	Odor. Container. Solids or liquids.	Personal hygiene, gloves, eye protection, ventilation, respirators
Coatings	Waterproofing, anti-corrosion, epoxies, polish, floor finish, varnish, waxes, cleaning spray, wood preservatives	Inhalation Ingestion Skin and eye contact Skin absorption	Flammable Combustible	Irritant to eyes, skin, nose, lungs, and throat. Toxic. Cancer. Nervous system. Damage to reproductive organs. Reduced fertility. Birth defects. Damage to bone marrow.	Skin, eyes, lungs, nervous system, reproductive organs, blood	Odor. Container. Liquids.	Personal hygiene, gloves, ventilation, eye protection, respirators

**Table 2-4 (cont.).** This table lists hazardous substances used in construction.

<b>Class</b>	<b>Examples</b>	<b>Entry Routes</b>	<b>Physical Hazards</b>	<b>Health Hazards</b>	<b>Target Organs</b>	<b>How Detected</b>	<b>Types of Protection</b>
Fuels	Diesel fuel, gasoline, kerosene, propane	Inhalation Skin and eye contact	Flammable Combustible	Damage to skin, eyes and lungs. Toxic-ingestion. Central nervous system. Irritant. Cancer	Skin, eyes, lungs, central nervous system, blood	Odor. Liquids. Appearance.	Personal hygiene, gloves, ventilation, eye protection. Approved containers. Bond and ground when filling.
Gases, compressed	Acetylene, oxygen, hydrogen, freon, ammonia propane, LPG, nitrogen	Inhalation Skin and eye contact	Flammable Combustible Oxidizer Compressed gas	Corrosive. Irritant. Damage to eyes and lungs. Asphyxiant. Heart attacks (freon). Toxic	Skin, eyes, lungs, central nervous system, heart	Odor (some). Compressed gas cylinder. Label on cylinder.	Handle, use, and store properly. Do not breathe gases. Use proper connections, equipment, and procedures.
Gases, noncompressed	Carbon monoxide, nitrogen, hydrogen sulfide, carbon dioxide	Inhalation	Flammable	Asphyxiant. Toxic to highly toxic.	Lungs, blood, central nervous system	Odor (hydrogen sulfide-rotten eggs). Others- none	Check confined spaces for oxygen, other gases, and vapors before entering. Ventilation.
Insulation (non-asbestos)	Foam, graphite, fiberglass, rock wool vermiculite, kaowool, inswool	Inhalation Skin and eye contact	None	Irritant. Damage to the lungs and eyes. Skin irritant.	Skin, eyes, lungs	Package. Application area. Fibrous solids or foams.	Ventilation, gloves, long sleeve shirts, respirators, coveralls, eye protection. Personal hygiene including showers.
Lubricants	Oils, greases, cutting oils	Inhalation. Skin and eye contact	Combustible Flammable	Lung, skin, and eye irritant. Cancer.	Skin, eyes, lungs	Appearance. Container. Liquid is usually thick.	Gloves, eye protection, ventilation. Personal hygiene.
Masonry	Brick, concrete, lime, muriatic acid, mortar, refractory brick, sand (silica), gunite refractory	Inhalation. Skin and eye contact	None	Skin, eye, and lung irritation. Damage to lungs. Corrosive to lungs, skin, eyes, and mucous membranes (muriatic acid).	Skin, eyes, lungs	Physical appearance. Dust when cutting, gunning, etc. Solids except muriatic acid.	Gloves, eye protection, ventilation, respirators. Personal hygiene. Chemical goggles when using acids
Metals	Cadmium, galvanized metal, babbitt metal, lead, nickel, manganese, zinc, chromium	Inhalation Ingestion	None as a solid metal. Many metal dusts are explosive	Irritating to the lungs. Damage to the lungs. Cancer. Toxic to highly toxic (cadmium fume and dust).	Lungs, blood, central nervous system	Appearance. Solids. Often coated on other metals or alloyed with other metals.	Personal hygiene. Eye protection, ventilation, respirators
Paint products	Enamel, latex, thinners, lacquers, primers, cleaners, strippers, removers, turpentine	Inhalation Skin and eye contact	Combustible Flammable	Due to wide range of hazardous materials in the products, health hazards range from skin irritations to coma or convulsions to cancer. Read MSDS for each product.	All body organs are possible target organs. See specific product's MSDS	Appearance. Odor. Liquid or paste.	Ventilation, respirators, eye protection, gloves, protective clothing. Personal hygiene.

**Table 2-4 (cont.).** This table lists hazardous substances used in construction.

Class	Examples	Entry Routes	Physical Hazards	Health Hazards	Target Organs	How Detected	Types of Protection
Pesticides, herbicides, fungicides	Baygon, DDVP, diazinon, parathion, many others	Inhalation Ingestion Skin absorption	Combustible Flammable Explosive	Toxic to highly toxic. Irritant.	Lungs, blood, central nervous system. Penetrates the skin.	Container should have EPA label on it. Liquids or powders.	Personal hygiene. Respirators, ventilation, protective clothing, eye protection. Use extra care when diluting/mixing concentrates.
Radioactive materials and lasers	Lasers, soil, or asphalt density instruments (radioactive source)	Eye and skin contact Inhalation	None	Lasers - damage to the eyes and skin. Radioactive - damage to the skin, lungs, and all internal organs. Cancer.	Skin, eyes, lungs, internal organs.	Warning labels on instruments using lasers or radioactive materials.	Do not handle, use, or service equipment unless trained to do so. Avoid eye exposure to laser beam and use proper eye protection when needed.
Solvents	Acetone, ketone, hexane, toluene, xylene, mineral spirits, methyl ethyl alcohol, chlorinated solvents	Inhalation Skin and eye contact Ingestion	Combustible Flammable	Toxic. Cancer. Irritant. Damage to the skin.	Skin, eyes, lungs, liver, central nervous system, kidneys. Peripheral neuropathy. Mucous membranes.	Odor. Liquids.	Ventilation, respirators, gloves, protective clothing, eye protection. Personal hygiene.
Welding, soldering, brazing, and cutting	Electrodes, solders, fluxes, lead, metals, compressed gas. See listing above	Inhalation Skin and eye contact	Compressed gases. Electrical and thermal burns.	Toxic to highly toxic fumes. Damage to eyes, skin, and lungs. Cancer. Irritant.	Skin, eyes, lungs, liver, central nervous system, blood.	Appearance. Solids. Pastes (fluxes).	Ventilation, special eye protection, respirators, protective clothing. Personal hygiene.
Wood products	Sawdust, pressure treated lumber, beech, mahogany	Inhalation Ingestion Skin contact Skin absorption	Combustible	Sensitization. Allergic reactions to some woods. Toxic.	Skin and lungs. Caution: A number of body organs may be affected by the products used to treat wood. Avoid exposure to sawdust when cutting this wood.	Appearance. Pressure treated wood may have color when it is fresh.	Ventilation, gloves, eye protection, respirators. Personal hygiene.

**Note:** This table is only a general overview of typical hazardous substances used in construction. The substances listed here may not be the same as you use on the job site. Therefore, you should review the MSDS for each product you use, especially the first time you use it.



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**SECTION 2 - ASSIGNMENT SHEET**

1. Define the following words:

Administrative controls \_\_\_\_\_

\_\_\_\_\_

Engineering controls \_\_\_\_\_

\_\_\_\_\_

Substitution \_\_\_\_\_

\_\_\_\_\_

Time weighted average \_\_\_\_\_

\_\_\_\_\_

2. Identify the following acronyms:

ACGIH \_\_\_\_\_

DOT \_\_\_\_\_

IDLH \_\_\_\_\_

MSDS \_\_\_\_\_

NFPA \_\_\_\_\_

NIOSH \_\_\_\_\_

PEL \_\_\_\_\_

TWA \_\_\_\_\_

3. List the requirements of the Hazard Communication Standard's written program.

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4. List the basic information that must be covered in the employer's training program for hazard communication.

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5. List the information an employer must provide each employee.

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6. List exposure control measures that protect workers from exposure.

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7. Demonstrate how to use MSDSs by answering the following questions. (Use the sample MSDS on pages 2-15 through 2-17.)
- a. What is the name of the product? \_\_\_\_\_
  - b. List the hazardous components of this product.  
\_\_\_\_\_  
\_\_\_\_\_
  - c. Is this product lighter than air?  
\_\_\_\_\_ Yes \_\_\_\_\_ No
  - d. What is the appearance and odor of this product? \_\_\_\_\_
  - e. What is the flash point of this product? \_\_\_\_\_
  - f. Is this product flammable or combustible? \_\_\_\_\_
  - g. What is the extinguishing media for this product? \_\_\_\_\_
  - h. Does this product contain cancer-causing components?  
\_\_\_\_\_ Yes \_\_\_\_\_ No
  - i. Is respiratory protection required while using this product?  
\_\_\_\_\_ Yes \_\_\_\_\_ No
  - j. What other PPE is to be used with this product? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
  - k. What special precautions should be taken when using this product?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
  - l. When was this MSDS revised? \_\_\_\_\_
  - m. What is the emergency phone number for this product?  
\_\_\_\_\_
  - n. Is emergency and first-aid information given?  
\_\_\_\_\_ Yes \_\_\_\_\_ No

8. List the information that must be given on a typical label.

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9. List the three basic types of labeling systems.

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10. Demonstrate how to read a label by answering the following questions. (Use either label in Figure 2-6 on page 2-19.)

- a. What is the name of the product?

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- b. Who makes it?

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- c. What is the physical hazard from this product?

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- d. What are the health hazards?

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- e. What are the target organs?

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- f. What are the safe handling recommendations?

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- g. What measures are to be used to limit worker exposure?

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h. What is the first aid information given?

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11. Complete the following questions using the chart. The chart describes a worker's exposure during a single working shift on a hazardous waste job site.

What is this worker's TWA for this particular day?

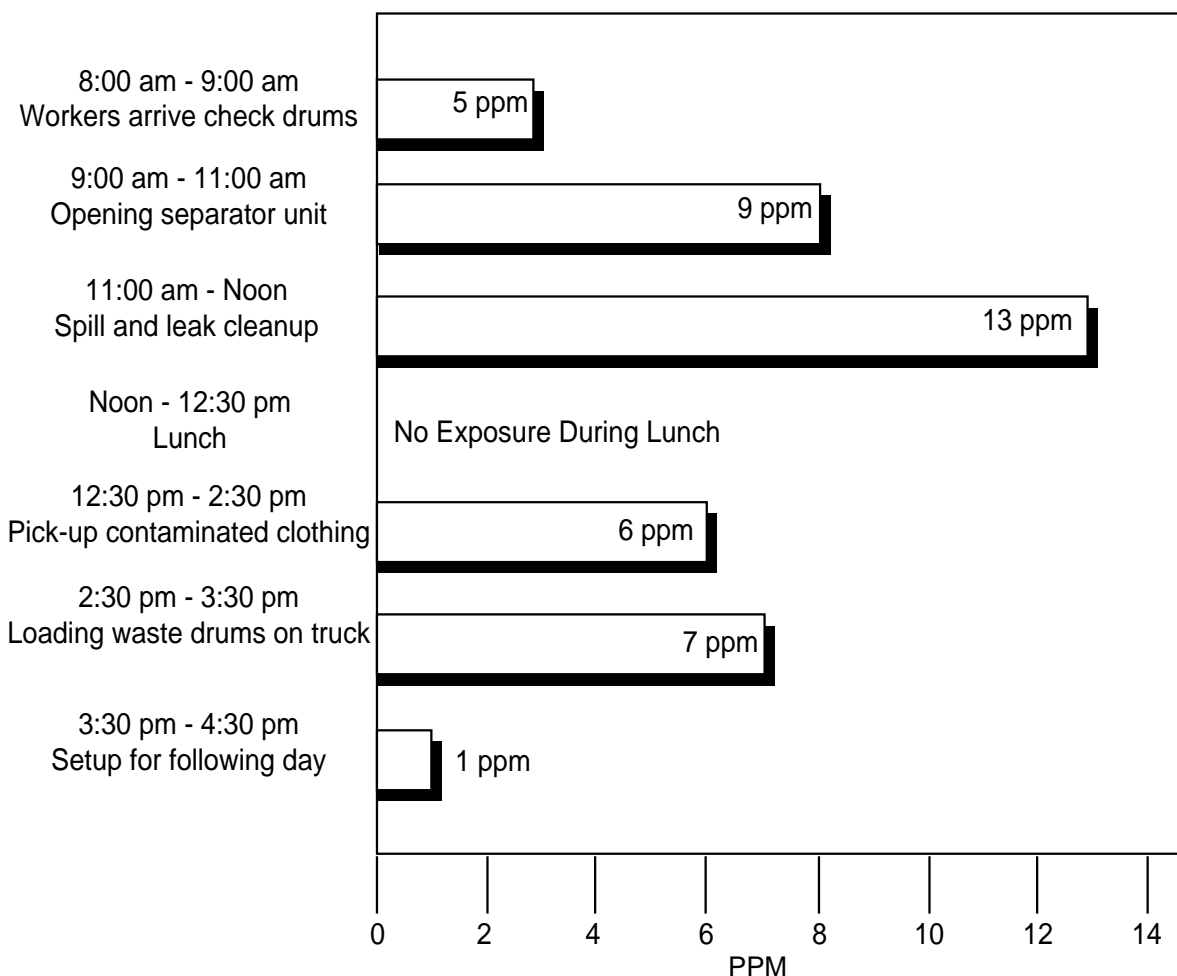
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Identify the worker's exposure if the PEL for this chemical is 5 ppm?

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Identify the worker's exposure if the PEL for this chemical is 9 ppm?

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# HAZARDOUS WASTE WORKER

Section

**3**

Title

**HEALTH EFFECTS**

## TRAINEE OBJECTIVES

After completing Section 3, you will be able to:

1. Match the following words with the proper definition or example:

Cancer	Latency period
Dose	Local effect
Ingestion	Olfactory fatigue
Inhalation	Systemic effect
Interaction	Target organs

2. Identify the following acronyms.

CTD          dB          PFT

3. List three routes of entry and give two examples of each.
4. List six warning signs of chemical exposure.
5. List four forms of heat stress and give the symptoms of each.
6. List the actions a worker should take to prevent heat stress.
7. List the actions an employer should take to prevent heat stress in an employee.
8. List three purposes of medical testing.
9. Monitor pulse, temperature, and weight.
10. List the circumstances under which a worker may be subject to drug or alcohol testing.



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**INTRODUCTION**

Worker health and safety involves a partnership between employers and workers. Employers are responsible for providing a safe and healthy workplace. Workers are responsible for following all safety and health rules and regulations. This section provides workers with information on the history of workplace hazards, health and physical hazards, and the physiology of the body. It's not possible to discuss the specific toxic actions of all substances, although where possible, examples have been used to illustrate the principles.

**HEALTH AND  
SAFETY IN THE  
WORKPLACE**

During the eighteenth and nineteenth centuries, as the population of industrial workers increased, the health and safety of workers became a growing concern. Many publications were developed and legislation was passed that was designed to protect the health of workers. The U.S. Public Health Service and the U.S. Bureau of Mines began studies of occupational diseases in the mining and steel industries around 1910. Two years later, the Public Health Service began investigating hazards in many industries. In 1913, New York and Ohio established the first state programs designed for the protection of workers. By 1948, all states had passed such legislation.

The development of organized labor began in 1886 when the American Federation of Labor (*AFL*) was formed by 25 craft unions. This event contributed to the growing interest in improving working conditions and reducing or eliminating health and safety hazards in the workplace. The Laborers' International Union of North America (*LIUNA*) was organized on April 13, 1903, with 25 delegates in 17 cities, and began the task of improving working conditions for Laborers.

Although these developments and others that followed contributed to improved working conditions, the problem remains enormous. Construction workers make up 5-6% of the work force in the U.S, but they account for 20-25% of all work-related deaths. The construction industry continues to be one of the most hazardous industries. Injuries to construction workers are six times more likely to be fatal than those occurring in the manufacturing sector and nine times more likely to be fatal than injuries occurring in the service sector. According to the

most recent Bureau of Labor Statistics data, the lost-workday injury rate for the construction industry is the second highest of any major economic sector. Many of the serious, work-related ailments of workers are not caused by an acute injury. Rather, they develop slowly over time. These conditions include:

- Musculoskeletal (muscles and skeleton) problems
- Lung diseases
- Illnesses caused by workplace exposures to chemicals, noise, vibration, radiation, and/or other hazards

The desire to eliminate injuries and diseases caused by the work environment led to the following three major pieces of legislation:

- Metal and Nonmetal Mine Safety Act of 1966 – Health and safety standards for mines are defined in this act. Also included in the act are provisions for mandatory reporting on an annual basis of all accidents, injuries, and occupational diseases of the mines; worker training; and federal and state coordination of inspection procedures.
- Federal Coal Mine Health and Safety Act of 1969 – This act sets forth additional mine requirements for ventilation and the use of respiratory equipment. It provides, to the greatest extent possible, working conditions in underground coal mines that are sufficiently free of respirable dust.
- Occupational Safety and Health Act (*OSH Act*) of 1970 – This act sets forth provisions to “assure, so far as possible, every working man and woman in the nation safe and healthful working conditions and to preserve our human resources.” Workplace inspections, noting violations, and penalties have increased the public’s awareness of health and safety hazards. Statistics show a decrease in worker loss time injury rates for construction in 1990-1993, from 6.6 to 5.4 hours per 200,000 hours. This decrease indicates that the OSH Act along with the safety-conscious efforts of the construction industry have had some effect on decreasing workplace injuries.

**PERSONNEL**

Various professionals within the occupational health field contribute to keeping workers safe and healthy. They include:

- Industrial hygienists
- Safety professionals
- Occupational health nurses and physicians

**Industrial Hygienist**

Industrial hygiene is a profession concerned with physical and health hazards that may impair the health and well-being of workers. An industrial hygienist has a degree or degrees in engineering, chemistry, physics, medicine, or a related biological science, and has acquired competence in industrial hygiene. The special studies and training must have provided the following abilities:

- To recognize the environmental factors and stresses associated with work operations and to understand their effects on humans and their well-being.
- To evaluate, on the basis of experience and with the aid of quantitative measurement techniques, the magnitude of these stresses and their ability to harm human health and well-being.
- To recommend methods to eliminate, control, or reduce such stresses when necessary to reduce the effects.

**Safety Professional**

Safety professionals study work operations, look for potential hazards, and make recommendations to employers and workers on how to minimize health and safety hazards. The safety professional is usually responsible for keeping health and safety records and issuing personal protective equipment (*PPE*), such as respirators, safety shoes, hard hats, and hearing protection. They also maintain an awareness of the potential for hazardous exposures and must investigate any work-related illnesses or injuries. They may be responsible for safety training and education.

**Occupational Health Nurse or Physician**

Medical personnel are responsible for carrying out health care programs using proper medical screening and recommendations to prevent worker disability. These

professionals have obtained by graduate training and/or extensive industrial experience, a wide knowledge of chemicals and physical agents, their health effects, the signs and symptoms of chronic and acute exposures, and the treatment of adverse health effects. They maintain appropriate records, as well as provide medical forms, literature, and other data needed for an effective medical program.

## **HEALTH AND PHYSICAL HAZARDS**

As the study of hazards progressed, it became apparent that there were two major categories of hazards—health and physical. Health hazards discussed in this section include:

- Chemical
- Biological
- Ergonomic

Physical hazards discussed in this section include:

- Temperature extremes
- Noise
- Radiation

All of these hazards can harm the body by causing illnesses or injuries over a short term and/or long term.

## **CHEMICAL HAZARDS**

A chemical is considered a poison (toxin) when it causes harmful effects or interferes with the way the body works. Only those chemicals that are associated with harmful health effects are designated as poisons. When a chemical is toxic to humans, it means the substance is poisonous to humans.

### **Dose**

Exposures result from inhaling chemical contaminants in the form of vapors, gases, dusts, fumes, or mists, by ingesting contaminants, or by absorbing them through the skin or eyes. The degree of the hazard depends on the *dose* of a substance. Dose is defined by the amount or concentration of a substance received over time. It is the most important factor in determining if a worker will have an adverse health effect from a chemical exposure.

Dose is determined by:

- The length of exposure – how long the worker is exposed: 1 hour, 1 day, 1 year, 10 years, etc.
- The concentration of a substance in the air – the amount absorbed through the skin, ingested and/or inhaled.

The longer a worker is at a particular job and the more chemical agent that gets into the air, on the skin, or is ingested, the higher the potential dose. In general, the greater the amount of the chemical that enters a worker's body, the greater the effect on the body. The connection between the amount and the effect is known as the dose-response relationship.

## Chemical Reactions

A *chemical reaction* occurs when chemicals combine to produce a new substance and a release of energy. The effects of one chemical may be increased by another chemical. Or the new substance may act differently than either of the original chemicals and be more hazardous. When household bleach and drain cleaner (lye) are mixed, they react to form two highly dangerous substances—chlorine gas and hydrochloric acid.

An *interaction* occurs when exposure to more than one substance results in a health effect different from the effects of either one alone. There are two types of interactions—synergism and potentiation.

## Synergism

*Synergism* is a process whereby two chemicals produce an effect that is greater than both of their effects together. For example, smoking one pack of cigarettes per day or being heavily exposed to asbestos may increase the risk of lung cancer 6 to 10 times that of a person who has had neither exposure. However, if a person smokes cigarettes and is exposed to asbestos, the risk of lung cancer may be 50 to 90 times higher than for someone who has not been exposed to either. Another example involves carbon tetrachloride (a solvent) and ethanol (drinking alcohol). Both substances can damage the liver. If a worker is overexposed to carbon tetrachloride and drinks too much alcohol, over time the liver damage can be much greater than the individual effect of each chemical added together.

**Potentiation**

*Potentiation* occurs when an effect of one substance is increased by exposure to a second substance which would not cause that effect by itself. For example, acetone does not damage the liver by itself, but it can increase the ability of carbon tetrachloride to damage the liver. However, only a few chemicals have been tested to see if they will interact with other chemicals. Therefore, it is a good work practice for workers to keep their exposures to all chemicals as low as possible.

**TYPES OF EXPOSURES**

A chemical exposure can be either an acute exposure or a chronic exposure.

**Acute Exposure**

An *acute exposure* is a single short exposure, or a few short exposures, usually to a relatively large concentration of a chemical. An acute exposure may have both immediate and delayed effects on the body. For example, ammonia causes an immediate irritation to the eyes and nose. However, if the dose is large enough, ammonia may cause severe respiratory distress, including *pulmonary edema* (fluid in the lungs), up to 6 hours after exposure. Another example is nitrogen dioxide produced during arc and gas welding. It may initially cause nose, eye, or throat irritation, but signs and symptoms of severe lung damage can occur 6 to 8 hours after exposure.

**Chronic Exposure**

A *chronic exposure* is a repeated exposure that occurs over months and years, usually at relatively low concentrations of the chemical. Chronic exposure is hazardous because some chemicals can accumulate in the body. Sometimes the body does not have enough time between exposures to repair itself.

The body has several organs that attempt to change chemicals to less toxic forms and eliminate them from the body. The liver and kidney are two examples. If the rate of exposure to a chemical is greater than the rate at which the chemical is eliminated, chemicals will build up in a worker's body. Ammonia does not accumulate in the body at all, while lead may be stored in the body for years, and asbestos remains in the body forever.

**TYPES OF HEALTH EFFECTS**

Health effects that result from chemical exposures can be described as either local or systemic and acute or chronic. Local and systemic refer to where the body is affected. Acute and chronic refer to how fast the effects occur. Chemicals can cause acute (short-term) or chronic (long-term) effects. Whether or not a chemical causes an acute or delayed effect depends on the chemical and the dose.

**Local Effect**

A *local effect* occurs when the body is harmed at the point where a chemical touches it. For example, benzene dries and irritates the skin it touches. Likewise, if battery acid is spilled on an arm, the burn received at the point of contact is the local effect. A local effect can also occur inside the body. For example, if a worker inhales acid vapors, they can burn the tissues in the mouth or lungs. The burns are a local effect.

**Systemic Effect**

A *systemic effect* develops in the body at some place other than the point of contact. For example, the solvent benzene has three routes of entry. It can be inhaled into the lungs, absorbed through the skin, or ingested through the mouth. Once inside the body, benzene can affect the bone marrow, leading to anemia and/or leukemia. (Anemia is a low red blood cell count in the blood. Leukemia is a cancer of the bone marrow.)

Toluene is another solvent, and it can be inhaled, absorbed through the skin or eyes, and ingested. Once in the body, it damages the liver. The liver is known as the target organ for toluene. A *target organ* is defined as that organ or system affected by a chemical.

**Prompt Effect**

A *prompt effect* occur quickly, usually after an exposure to a high concentration of a hazardous material. Most prompt effects are temporary and go away shortly after the exposure is removed. However, permanent damage can occur if exposures are high enough. Examples of chemicals and their prompt effects include the following:

- Carbon tetrachloride – Causes dizziness, nausea, and at higher concentrations, coma and death. (Sometimes used as a degreaser or solvent.)
- Acid mists – Causes eye and throat irritation, coughing, sore throat, and chest pain.

For most substances, neither the presence nor absence of prompt effects can be used to predict whether delayed effects will occur. Dose is the determining factor. Exposures to cancer-causing substances (*carcinogens*) and sensitizers may lead to both acute and delayed effects.

A *sensitizer* is a chemical that can cause an allergic response in the body. Not every person will have an allergic reaction following an exposure to a sensitizer, nor will all persons react with equal severity. Some allergic reactions can even be fatal. The skin and lungs are the organs most likely to be affected by a sensitizer. Allergic reactions can include signs and symptoms such as dermatitis, hives, sneezing, headaches, and asthma.

Chemicals known to be sensitizers include nickel, toluene diisocyanate, and formaldehyde. Some common environmental sensitizers are poison oak and poison ivy.

#### Examples of Prompt Health Effects on the Body

Chemicals found in hazardous waste work vary. They can affect various parts of the body with a wide range of effects. Examples include:

- Lungs
- Brain
- Nervous system
- Kidneys
- Skin

#### *Lungs*

Some chemicals irritate the lungs and some sensitize the lungs. Fluorides, sulfides, and chlorides are found in various welding and soldering fluxes. During welding and soldering, these materials can combine with the moisture in the air to form hydrofluoric, sulfuric, and hydrochloric acids. All three of these acids can severely burn the skin, eyes, and respiratory tract. High levels can overwhelm the lungs, burning and blistering them, and causing pulmonary edema.

*Brain and Nervous System*

When inhaled, solvent vapors enter the blood stream and travel to other parts of the body, particularly the nervous system. Most solvents act like narcotics. They depress and slow down the nervous system causing symptoms such as:

- Dizziness
- Headaches
- Feelings of drunkenness
- Fatigue

One result of these symptoms may be poor coordination that can contribute to falls and other accidents on the site. Exposure to solvents may also increase the effects of alcohol.

*Kidneys*

The kidneys are one of the organs that rid the body of wastes. Kidney damage can occur after exposure to solvents and heavy metals, such as lead, nickel, and cadmium. Symptoms of kidney damage are fatigue, lower back pain, and blood in the urine. Severe damage may cause kidney failure.

*Skin*

Chemicals that touch the skin can cause rashes, ulcers, blisters, and other skin disorders. Effects can occur immediately or within hours, days, weeks, or months after exposures. Most of the solvents cause some type of *dermatitis* (inflammation of the skin). Corrosives cause burns of varying severity.

**Delayed Effect**

Delayed effects take a long time to develop. Usually, they are the result of repeated exposures to low doses of a substance over a long period of time. Delayed health effects may or may not be reversible. Examples of chemicals and their delayed effects include:

- Carbon tetrachloride – Can cause liver damage or cancer 10 to 40 years after the first low level exposures.
- Asbestos - Can cause asbestosis or cancer of the lung, pleura, stomach, or intestines. (Has no prompt effects on the body)
- Acid mists – Can cause chronic bronchitis or emphysema.

### Latency Period

The time period between the first exposure and the appearance of disease caused by the exposure is called the *latency period*. Some delayed effects have very long latency periods (10-40 years.) The following are examples of latency periods:

- 10 years – benzene
- 15 years – vinyl chloride
- 25 years – arsenic

The concept of latency is one that workers should fully understand. Exposure to a substance may cause adverse health effects many years after the time of exposure, with little or no effects at the time of exposure. Therefore, it is important to avoid or eliminate all exposures to hazardous substances when possible.

For many chemical agents, the adverse health effects following a single exposure are different from those produced by repeated exposures. For example, the primary prompt effect of benzene is central nervous system symptoms, but after repeated exposures, the delayed effect can be leukemia.

### Chronic Diseases

A chronic disease is a disease that once contracted tends to last a long period of time. Cancer is often used as an example of a chronic disease. However, there are many other types of chronic diseases that can be as serious as cancer. Chronic diseases affect the functions of different organs of the body.

### *Chronic Lung Disease*

Chronic exposure to asbestos or silica dust (fine sand) causes scarring of the lung. The resulting diseases are asbestosis (asbestos) and silicosis (silica). Exposure to gases, such as nitrogen oxides or ozone, may destroy parts of the lungs. No matter what the cause, a chronic lung disease will make an individual feel short of breath and limit his/her activity. Depending on the extent of disease, chronic lung disease can kill. In fact, it is one of the top ten causes of death in the United States.

*Scarring of the Liver*

Scarring of the liver is called cirrhosis, and it is a chronic disease. It's also one of the top ten causes of death in the United States. The liver is important for making specific essential substances used by the body and for detoxifying specific substances for elimination from the body.

Chronic liver disease can cause the following health effects:

- Individuals feel tired all the time
- Muscles waste away
- Stomach swells from fluid accumulation (ascites).

Many chemicals can cause cirrhosis of the liver, such as carbon tetrachloride, chloroform, and alcohol. Biological agents (viruses) also may damage the liver. A viral infection, such as Hepatitis B, may cause severe injury to the liver and lead to chronic disease or death.

*The Brain*

The brain is also affected by chronic exposure. Over a period of time, chemicals can decrease IQ, decrease the ability to remember things, and/or change personalities. These changes are usually small. Laborers exposed to solvents, such as toluene or xylene in oil-based paints, may find that their brain is affected in these ways over time.

*Chronic Kidney Disease*

Kidney scarring is another example of a chronic disease. Individuals who have severe kidney damage may need to be either placed on dialysis to remove the body's harmful waste products or undergo a kidney transplant. Chronic kidney disease has many symptoms. Examples include:

- Feeling tired all the time
- High blood pressure
- Swollen feet

Heavy metals, such as lead and mercury, as well as solvents are suspected of causing chronic kidney disease.

*Cancer*

Cancer is a chronic disease. Chemicals that cause cancer are called *carcinogens*. Arsenic, asbestos, and benzene are examples of carcinogens. There are **no safe levels of exposure** for carcinogens. Exposure guidelines are set at levels that reduce the probability of developing

cancer from certain chemicals. Workers should keep their exposure to any chemical suspected of causing cancer as low as possible. This is true even if the exposure is below the current, acceptable standards.

Cancer is not a single disease, but many diseases affecting different parts of the body. It is not true that “everything causes cancer” when taken in large enough doses. In fact, most substances do not cause cancer, no matter how high the dose. The problem is that the number of chemicals that do cause cancer is unknown. There are more than 60,000 chemicals used commercially today. Of these, fewer than 400 have been adequately tested to prove or disprove that they cause cancer. About half of the 400 have been shown to cause cancer in laboratory animals. Currently, the National Toxicology Program lists 65 agents, substances, mixtures, and exposure circumstances that are known to cause cancer. Appendix 3-1 lists these carcinogens.

Determining the causes of cancer in humans is difficult. Cancer usually has a long latency period (10-40 years). A chemical must be in use for many years before enough people have been exposed for long enough periods of time for researchers to see a pattern of increased cancer cases. Also, it is difficult to determine if increases in cancer in humans is caused by exposure to one particular substance. Exposure may have occurred many years ago and been unknown or forgotten. In addition, workers are usually exposed to many different substances over a working lifetime. These factors make it difficult to establish a relation between the cause (a chemical) and the effect (cancer).

The study of cancer in humans is expensive, difficult, and requires that people be exposed to a chemical that may cause cancer (and risk getting cancer). Therefore, chemicals are tested using laboratory animals. Animal studies involve exposing test animals to large doses of chemicals. If these doses cause cancer in a significant number of test animals, the information is then used to try to predict the risk for humans. However, animal tests are expensive, take about three years to perform, and often do not provide final, clear, and conclusive results.

**PHYSICAL WARNING SIGNS**

Physical warning signs are indications that hazardous conditions may exist. Workers should watch for the physical signs of exposure to toxic chemicals. If any of these signs occur, leave the area and report the problem to the supervisor immediately. Workers should not return to the area until the cause of the symptoms has been checked by a qualified person.

The six physical warning signs of chemical exposure are:

1. Breathing difficulties – breathing faster or deeper, soreness, a lump in the throat
2. Dizziness, drowsiness, disorientation, difficulty concentrating
3. Burning sensation in the eyes or on the skin
4. Weakness, fatigue, lack of energy
5. Chills, upset stomach
6. Odors and/or a strange taste in the mouth

**ROUTES OF ENTRY**

Chemicals can enter the body in three ways, and they are called routes of entry. The three routes of entry are:

1. Inhalation
2. Absorption
3. Ingestion

When a route of entry is specified for any chemical, it refers to the primary way a chemical enters the body. It does not mean that it's the only route of entry. Most chemicals are not equally toxic by all routes of entry.

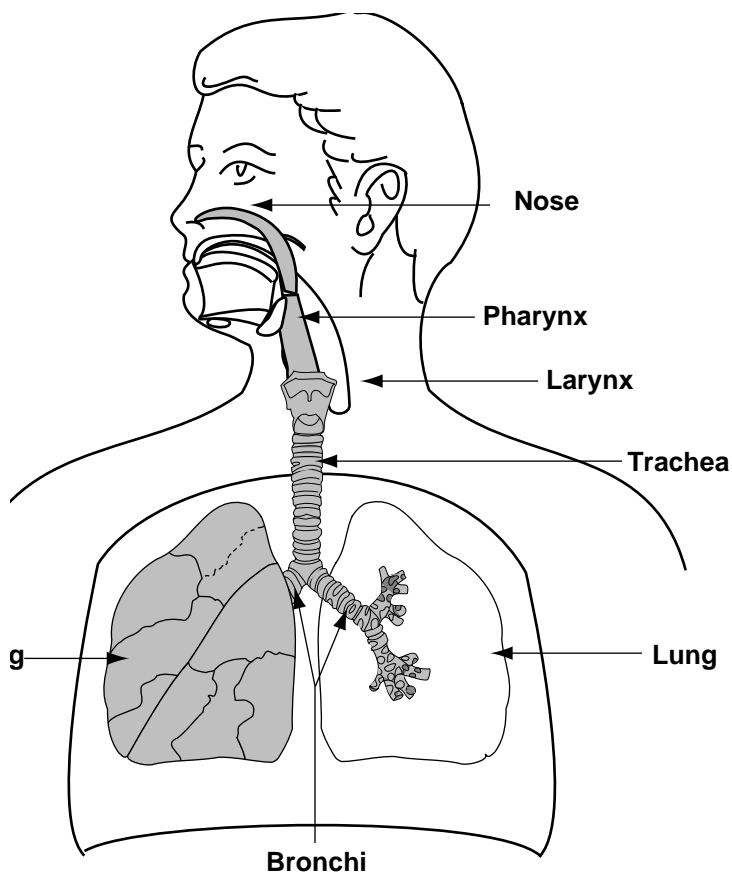
**INHALATION**

Inhalation is the most common route of entry for toxic chemicals to enter the body. Chemicals usually do more damage when inhaled because they are absorbed quickly through the lungs. Also, since breathing is always occurring, there is a constant opportunity for exposure. The average resting adult breathes 5 liters (0.2 cubic feet) of air per minute. The breathing rate can increase to 20 liters (0.7 cubic feet) per minute when performing hard physical labor. This is a large volume of air. In order to understand inhalation as a route of entry, it is necessary to understand a little about how the respiratory system functions.

## The Respiratory System

The respiratory system consists of all the organs of the body that contribute to normal breathing. These organs include the lungs as well as the airways leading to the lungs (Figure 3-1). The body's first defenses against contaminants are found in the airways. The airways are:

- Nose
- Pharynx
- Larynx
- Trachea
- Bronchi



**Figure 3-1.** The Respiratory System

The lungs are constantly exposed to the surrounding atmosphere. About twenty times a minute, they take in the surrounding air, along with whatever foreign particles happen to be floating in it, at whatever temperature it may be. To compensate, the lungs have some remarkable protective devices.

Air enters the nostrils and passes through a web of nasal hairs. The air is warmed and moistened as some particles are removed by collecting on the nasal hairs and at the bends in the air path. The interior walls of the nose are covered with membranes that secrete a fluid called mucus. The mucus drains slowly into the throat and serves as a trap for bacteria and dust in the air. It also helps dilute toxic substances that enter the airway.

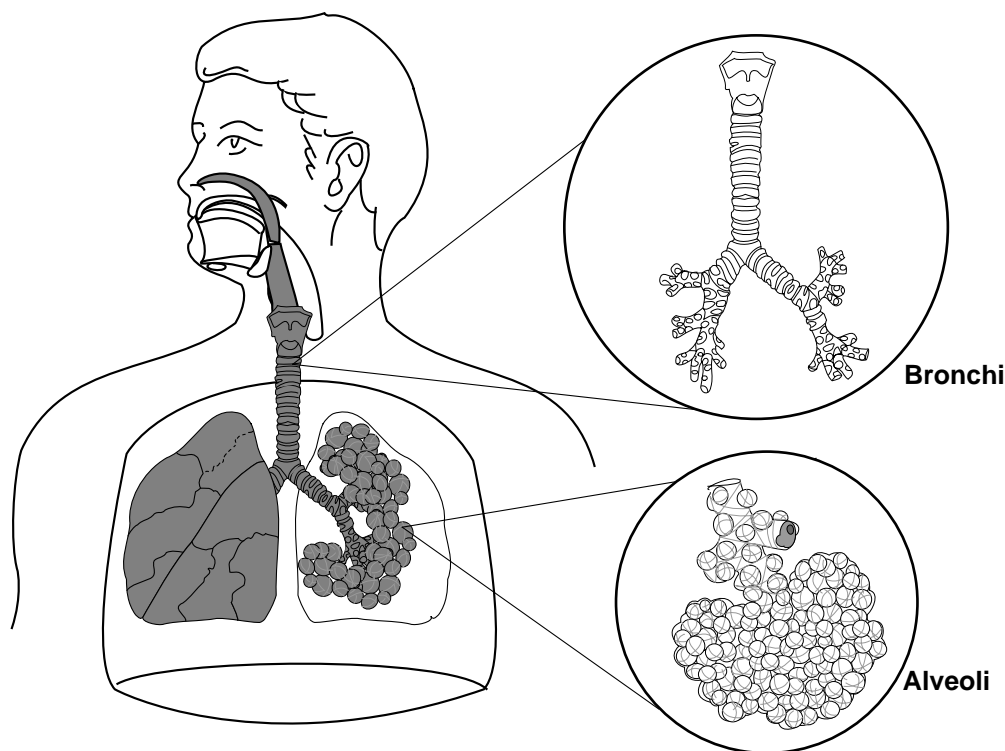
The cilia, another important air cleaner, are hair-like projections that whip back and forth constantly. The millions of cilia lining the nose and upper airways help the mucus clean, moisten, and heat the air before it reaches the lungs. The movement of the cilia is always toward the outside of the body. In this way, they push foreign matter upward, away from the delicate lung tissues, so that it can be spit out or swallowed. Particles that are too large for the cilia to get rid of usually stimulate a sneeze or a cough which will forcibly expel them. The cilia plus the mucus are called the mucociliary escalator.

From the nasal passage, the air moves down through the trachea and into the bronchi. Bronchi are the large airways into the lungs and are located one on each side of the chest. They divide and subdivide into smaller, finer, and more numerous tubes, much like the branches of a tree. There are approximately 25 to 100 million branches in the bronchi. The smallest branches end in more than 300 million air sacs called alveoli (Figure 3-2).

While the other structures of the respiratory system move air in and out of the lungs, the alveoli deliver oxygen to the blood for circulation throughout the body. They also pick up carbon dioxide from the blood for exhalation. Blood acts like a tank car, unloading carbon dioxide and loading oxygen for distribution throughout the body.

### **Natural Defenses**

Both rate and depth of respiration increase with heavy work. This increase in respiration means a greater amount of air and possibly toxic substances getting into the lungs. The body has natural defense systems to combat toxic substances and foreign particles.



**Figure 3-2.** The Location of the Bronchi and Alveoli in the Lungs

Natural defense systems include:

- **Coughing** – Coughing is one of the first signs of air passage irritation. It may occur at the time of an adverse exposure or may be delayed. Delayed effects often occur first thing in the morning.
- **Sputum production** – Sputum is a mucus secretion of the respiratory airways. Sputum production works to help clear toxic particles, especially at night while lying down.
- **Macrophage cell production** – A macrophage is a large white blood cell that ingests (eats) foreign particles. It is another method the body uses to eliminate particles from the air passages.

Certain toxic substances (nicotine in cigarettes) disable the normal protective mechanisms of the lungs. This increases the damage caused by exposure to other toxic substances, such as tar in cigarettes.

**Susceptibility of the Lungs to Toxic Substances**

The structure of the lungs allows oxygen to be absorbed quickly into the bloodstream. First, the lungs have a large surface area. If the branching airways of the lungs were stretched out to a layer one cell thick, they would cover approximately 75 square yards, an area about the size of a tennis court. In addition, the body's blood vessel network has 117 square yards of surface area and a continuous blood flow. However, these traits also make it easy for some toxic chemicals to enter the bloodstream quickly. A worker may inhale a toxic gas that is absorbed so fast, it is not detected until ill effects set in.

Some substances are *insoluble*, which means they can not be absorbed into the bloodstream. They are trapped in the lungs for long periods of time, while the body tries to destroy or remove them. These substances may cause adverse health effects, such as:

- Allergic reactions
- Cancer
- Emphysema
- Fibrosis
- Inflammation
- Irritation
- Pulmonary edema
- Sensitization

The fate of a substance that reaches the lungs depends on its *solubility* and reactivity. The more soluble the contaminant, the more likely it will be an upper respiratory irritant, such as sulfur dioxide. The more soluble reactive particles may cause acute inflammatory reactions and a build-up of fluid in the lungs (pulmonary edema). The less soluble materials may reach the lower lungs causing lung dysfunction. Or the particles may stick in the alveoli and be engulfed by *macrophages* that can move them back to the mouth where they are swallowed. Some chemicals that reach the digestive tract by this method may then be absorbed.

The size of the particle greatly influences where it will be deposited in the air passages. Normally the larger the particle, the closer to the mouth it is deposited. Smaller particles may move to the lower portions of the lungs.

Inhaled contaminants that adversely affect the lungs or body fall into three categories:

1. Aerosols and dusts – May cause either tissue damage, tissue reaction, disease, or physical plugging when deposited in the lungs.
2. Toxic gases – May produce adverse reactions in the lungs' tissues. For example, hydrogen fluoride is a gas that causes chemical burns.
3. Toxic aerosols or gases that don't affect the lung tissue, but are passed into the bloodstream – The blood carries the substance to other organs, and/or it affects the ability of the blood to carry oxygen. For example, an inhalation exposure to solvents may result in impairment of the central nervous system, liver, or kidneys.

Three things must be known about inhaled contaminants before the toxic effects can be determined:

1. Identity of the contaminant
2. Dose
3. Frequency of exposure

Every part of the respiratory system can be injured from inhaling certain kinds of gases and particles. Injuries or changes that result from contaminated air include:

- Airflow resistance through the bronchi
- Formation of a large amount of mucus
- Paralysis or destruction of cilia
- Cell injury
- Development of scar tissue (pulmonary fibrosis)
- Change to the cell structure or the formation of cancer

The type and severity of the body's response is related to the dose and the nature of the specific contaminant present. Air that looks dirty or has an offensive odor may pose no threat to the tissues of the respiratory system. In contrast, some gases that are odorless, or at least not offensive, can cause severe tissue damage. Particles that normally cause lung damage are so small

they can't even be seen. Many times, however, large visible clouds of dust are a good indicator that smaller particles are also present. Sandblasting is one activity that involves a risk of this type of exposure.

One way to gauge lung damage is to measure vital capacity. Vital capacity is the amount of air that a person can get into their lungs with deep inhalation. This type of measurement is called a pulmonary function test (*PFT*). If the vital capacity of the lungs is tested before any exposure (baseline), then early damage can often be detected by testing after an exposure. When a baseline record of a healthy organ exists, in this case the lung, testing after a job is over, at the termination of a job, or annually may indicate injury as the PFT results show decreases over time. The trend may indicate the need to take some action at the job quickly. Trends may also indicate early onset of irreversible disease processes before permanent lung damage has developed. Normal activity, age, race, sex, and height are taken into consideration for an accurate assessment of lung functions.

### **Health Effects of Airborne Contaminants**

Worker exposures are often the result of airborne contaminants, such as dusts, fumes, gases, mists, or vapors. Each of these contaminants have different actions and physical properties. These contaminants are instrumental in creating respiratory hazards, such as oxygen deficiency and contaminated air.

#### **Dusts**

Some dusts have no effect on the body. They don't seem to harm the body or be changed by the body's chemistry into other harmful substances. Most harmful dusts cause damage only after being inhaled. Others, like cement and arsenic, can also directly affect the skin. Sandblasting is an activity where workers are at high risk of silica exposure.

Pneumoconiosis (pronounced, new-mo-cone-e-o-sis) is a broad term used to describe lung injury caused by the delayed effects of breathing dusts.

#### **Fumes**

Many fumes irritate the skin and eyes. However, these fine particles primarily affect the body when they're inhaled. An inhalation exposure sometimes results in an

prompt effect referred to as metal fume fever, especially if the fumes are from metals such as zinc, cadmium, or magnesium.

The small size of the fume particles allows many of them to get past the body's natural defenses. They can then reach and irritate the lungs. Their small size and ability to spread out in the lung fluids allows fumes to pass easily from the lungs into the bloodstream, thereby damaging other parts of the body. Many fumes, such as lead fumes, affect the liver, kidneys, and nervous system. They are called systemic poisons.

#### Gases

Toxic gases can directly irritate the skin, throat, eyes, or lungs. They may also pass from the lungs into the bloodstream, damaging other parts of the body.

The body's defenses against some gases include detecting smells, tearing eyes, and coughing. Ammonia's irritating effects and odor warn workers of exposure. However, workers may be exposed to some gases without knowing it, such as carbon monoxide.

Some gases may dull the sense of smell after a while. This condition is called *olfactory fatigue*. Hydrogen sulfide with its characteristic rotten egg odor is such a gas. After a short exposure to hydrogen sulfide, a worker is no longer able to smell the gas. The natural warning sign provided by the sense of smell no longer occurs. Therefore, the sense of smell is a poor way of detecting any type of exposure to hazardous substances, and should not be relied on.

#### Mists

Many mists and fogs damage the body if they are inhaled, or if they make direct contact with the skin and eyes. Like fumes, mists are small enough to by-pass the respiratory system's defenses and get deep inside the lungs. There they pass easily into the bloodstream to other parts of the body. Examples include acid spray mists and paint spray mists.

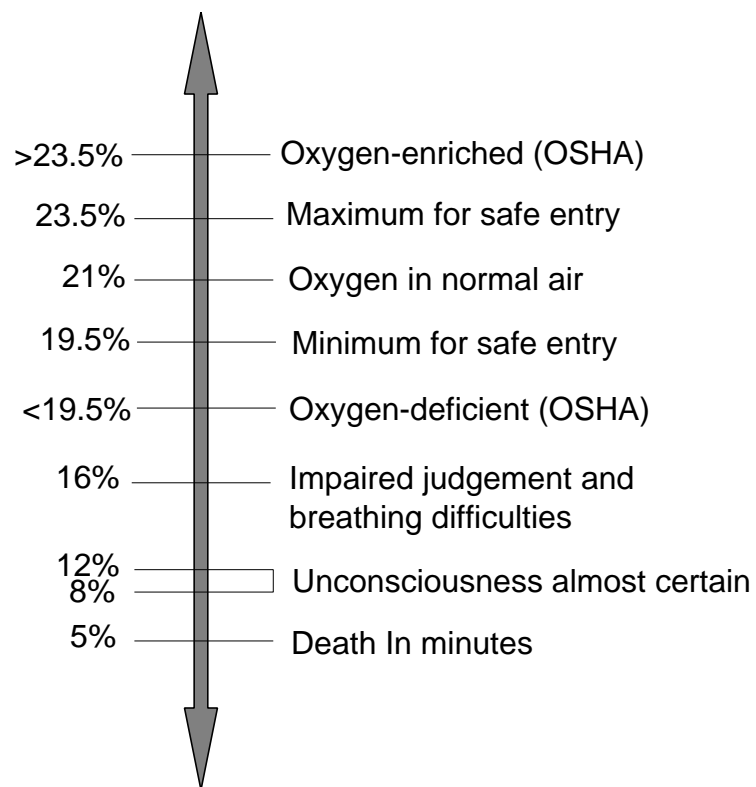
#### Vapors

Both vapors and the materials from which they evaporate can harm the body. Many vapors directly affect the skin causing dermatitis, while some can be absorbed through the skin. When inhaled, most vapors

pass through the lungs to the bloodstream and damage other parts of the body. Some of these materials can cause cancer or damage the liver, kidneys, and blood. Solvents are common materials that give off vapors as they evaporate.

### Oxygen Deficiency

The body requires oxygen to live. If the oxygen concentration decreases, the body reacts in various ways as shown in Figure 3-3. Death occurs rapidly when the concentration of oxygen in the air falls below 5%.



**Figure 3-3.** Oxygen Levels and Effects on the Body

Oxygen deficiency is a major health hazard that can result from an *asphyxiant*. There are two main types of asphyxiants. Both can cause loss of consciousness, serious injury, and death.

The two types of asphyxiants are:

1. Simple asphyxiant – Chemical gas or vapors at such a concentration in a confined space that the oxygen content is below a level that will sustain life.
2. Chemical asphyxiant – Substance that reduces or blocks the ability of the blood to carry oxygen.

#### Simple Asphyxiant

A simple asphyxiant has little or no ability to harm the body as a poison, but when it's present in high concentrations, it displaces oxygen. In this way, it creates an atmosphere that cannot support life.

Examples of simple asphyxiants include:

- Methane
- Carbon dioxide
- Natural gas
- Nitrogen
- Helium

#### Chemical Asphyxiant

A chemical asphyxiant reduces or blocks the body's ability to carry or transfer oxygen. Some chemicals combine with the hemoglobin in red blood cells. (Hemoglobin is the part of the blood cell that carries the oxygen.) For example, carbon monoxide binds more easily with hemoglobin than oxygen does. Therefore, when carbon monoxide is present in the blood, it prevents the blood from picking up oxygen and transporting it to the body's cells. The amount of oxygen carried to the body cells, including the vital organs (e.g., brain, heart), is reduced.

Exposures to high levels of carbon monoxide can prevent the body from getting enough oxygen, severely affecting the heart and brain. Early symptoms of carbon monoxide exposure are headache, dizziness, and nausea. Higher exposures can result in passing out, coma, or even death. People with existing heart conditions are more likely to suffer additional heart damage if exposed to carbon monoxide. Smokers already have higher than normal levels of carbon monoxide in their bloodstreams. A burning cigarette produces fairly high carbon monoxide levels. In addition, carbon monoxide is present in the

exhaust from heavy equipment, generators, or compressors. It is also produced as a by-product of welding and soldering operations.

Other chemical asphyxiants interfere with processes that transfer oxygen from the lungs to the blood, or from the blood into the body cells. Examples of these asphyxiants include hydrogen sulfide and hydrogen cyanide. The result is that the body doesn't have enough oxygen to sustain life.

## **ABSORPTION**

Absorption is the route of entry into the body through the skin (either broken or unbroken) and sometimes through the eye. The skin is the largest organ of the body, covering about 19 square feet of surface area. Like the lungs, the skin has a large network of blood vessels close to the surface. Chemicals are absorbed or passed through the skin and enter the bloodstream. These chemicals then travel to other organs and cause damage. Many chemicals, especially solvents, dissolve the oils in the skin. The skin becomes dry and cracked, making it easier for other chemicals to be absorbed through the skin and into the bloodstream.

### **The Skin's Functions**

The skin performs three important functions:

1. Protects the body
2. Regulates body temperature
3. Contains nerve receptors

#### **Protects the Body**

The skin is often the first barrier against hazardous contaminants. Intact skin provides a protective barrier and hinders the absorption of chemicals. When a substance touches the skin, five actions are possible:

1. The skin and its associated layer of fat (lipid) cells act as an effective barrier against penetration, injury, or other forms of irritation.
2. The substance reacts with the skin surface and causes a primary irritation, such as dermatitis (a local effect).

3. The substance penetrates the skin and accumulates in the tissue, resulting in allergic reactions (skin sensitization).
4. The substance penetrates the skin, enters the bloodstream, and acts as a poison to other parts of the body (systemic effect).
5. The substance penetrates the skin, dissolves the fatty tissues, and allows other substances to penetrate the skin layers.

Each individual's skin reacts in different ways when exposed to the same chemical, physical hazard, or biological contaminant. The skin must protect the body against:

- Bacteria and fungus
- Injury to sensitive internal organs
- Radiation from the sun
- Moisture loss
- Penetrating objects

#### Regulates Temperature

The skin also regulates body temperature. One square inch of the skin contains about 15 feet of blood vessels. These blood vessels expand (dilate) when the body needs to lose heat, or shrink (constrict) when the body must retain heat. There are about 2 million sweat glands over the surface of the body that are controlled by a heat regulator in the brain. As temperature increases, the body uses the evaporation of sweat from the skin to get rid of excess heat.

#### Contains Nerve Receptors

The skin is the organ that senses touch for the central nervous system. The nervous system in the skin contains hundreds of pain receptors, plus pressure, heat, and cold receptors.

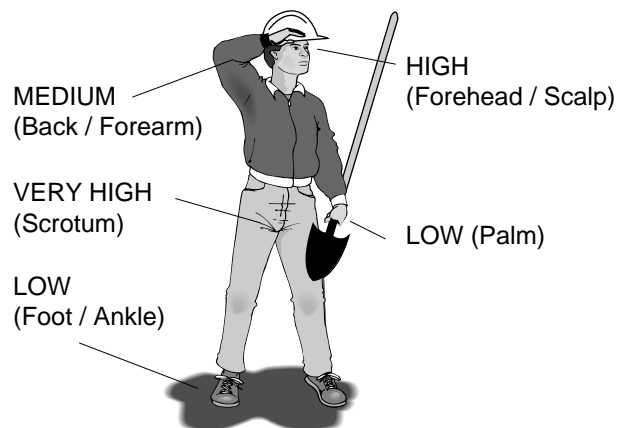
#### Health Effects

Most job-related skin conditions are caused by repeated contact with irritants, such as:

- Solvents
- Soaps and detergents
- Particulate dusts
- Oils and grease
- Metal working fluids

The resulting skin irritation is called contact dermatitis and has symptoms such as red and itchy skin, swelling, ulcers, and blisters. Dermatitis accounts for 30% of all reported occupational illnesses and is the number one occupational disease. The severity of the reaction depends upon the dose, as well as the presence of abrasions, sores, and cuts which open a pathway through the skin and into the body.

Different parts of the body absorb chemicals at very different rates (Figure 3-4). Serious and even fatal poisonings have occurred from brief skin exposures to highly toxic substances, such as parathion or other related organic phosphates (weed and insect killers), phenol, and hydrocyanic acid. Compounds that are good solvents for grease or oil, such as toluene and xylene, may cause problems by being readily absorbed through the skin. Abrasions, lacerations, and cuts may greatly increase the absorption, thus increasing the exposure to toxic chemicals.



**Figure 3-4.** Absorption Rates for Male Workers

## Eye Injuries

The importance of the human visual system in life is clear. Of all the major body organs prone to work-site injuries, the eye is probably the most vulnerable. Consequently, protection against eye and face injuries is a major concern for workers and employers.

The eye is an organ of sight and is not designed for the demands of prolonged viewing at close distances seen in today's workplace. Although the eye does have some natural defenses, it has none to compare with the healing ability of the skin, the automatic cleansing abilities of the lungs, or the recuperative powers of the ear. For this reason an eye injury may be described as the most traumatic loss to the human body.

### Eye Hazards

Of physical injuries, foreign materials entering the eye is by far the most common. Effects that can be expected from foreign bodies entering the eye are:

- Pain - The cornea of the eye is densely covered with nerves and any object sitting on the surface of the cornea causes pain.
- Infection - Bacteria or fungi may be carried to the eye on a foreign particle or by fingers used to rub the eye.
- Scarring - Tissue scarring that has healed may obscure vision.
- Damage - The eye may be damaged by particles flying into the eye. The severity will depend on the angle and point of entry, as well as the speed of a particle.

Heat can damage eye and eyelid tissue just as it does other body tissue. High intensity light may have sufficient energy to damage the eye tissue. Exposure to ultraviolet (UV) light from welding operations (known as welder's flash) may severely damage the eye.

UV light from the sun may also damage the eyes. Results from many studies show that long hours spent in the sun without adequate protection increases the risk of developing cataracts. Workers can also receive indirect UV exposure as sunlight reflects off of snow, sand, water, and concrete.

The effects of accidental chemical exposure to the eye can vary from mild irritation to complete loss of vision. In some cases, a chemical that does not actually damage the eye may be absorbed through the eye tissue in sufficient quantities to cause systemic poisoning.

Exposure to caustics are much more damaging to the eyes than acids. On the first day after a caustic exposure, the eye may not look too bad. However, it may deteriorate markedly on succeeding days. This is in contrast to acid burns where the initial appearance is a good indication of the ultimate damage.

## Eye Protection

Eyes need protection from flying particles encountered in jobs, such as chipping, grinding and overall construction work. Workers on hazardous waste sites should also be protected from possible chemical exposures to the eyes. General types of protective equipment are:

- Glasses with impact resistant lenses and side shields
- Cushion fitting goggles
- Face shields

To protect the eyes from damaging UV light, it is necessary to wear glasses that block 99% to 100% of the UV light. Glasses with labels that say, “blocks dangerous UV rays” are not enough. To ensure sufficient protection against UV light, the glasses must be labeled as follows:

- UV absorption up to 400 *nanometers (nm)*
- Special purpose
- Meets ANSI UV requirements

Visible and infrared light also produce harmful effects and should be protected against.

## INGESTION

Ingestion is the third route of entry. It is the act of taking food or any substance into the body by the mouth (eating or drinking). Many workers on the job site unknowingly ingest harmful toxic chemicals. These toxic chemicals are then absorbed from the *gastrointestinal tract* into the blood. Lead oxide, found in the red paint on I-beams, causes serious problems if ingested through eating or smoking. Good personal hygiene habits, such as thoroughly washing face and hands before eating, are essential to preventing exposure by ingestion.

Inhaled toxic dusts can also be swallowed in amounts large enough to cause poisoning. (The mucociliary escalator moves the dusts and mucus out of the

respiratory tract and into the mouth where it is swallowed.) If a toxic material is easily dissolved in digestive fluids, the absorption into the bloodstream is sped up. Ingestion toxicity is normally lower than inhalation toxicity for the same material. The reason is that many chemicals are not easily absorbed from the intestines into the bloodstream.

After absorption from the intestinal tract into the bloodstream, the toxic material generally goes to the liver. The liver detoxifies the material, which means it changes or breaks down the material. This detoxification process is an important body defense mechanism.

Liver detoxification involves the following steps:

1. Toxic substance is deposited in the liver.
2. The liver changes the substance from toxic to nontoxic (detoxifies).
3. Blood carries the nontoxic substance to the kidneys.
4. Substance is excreted through the kidneys and urinary tract.

The liver cannot always detoxify a toxic substance. Sometimes the process has the reverse effect. The liver breaks down a toxic substance into components that are more toxic than the original. These components may build up in the liver to cause adverse health effects. They may also be transported to other body organs, damaging them.

## **REPRODUCTIVE HAZARDS**

Exposure to some chemicals can affect the reproductive health of a man or woman. Infertility, problems during pregnancy, and birth defects may result from chemical exposures.

Male fertility may be affected by exposure to certain chemicals. Sperm production may be abnormal, reduced, or stopped entirely. For example, male workers at a plant that manufactured a pesticide called dibromochloropropane (*DBCP*) realized after talking among themselves that none of their wives had become

pregnant. When tested, the male workers found they had reduced sperm counts, which was attributed to their exposure to DBCP.

A female worker may be unable to become pregnant or may have frequent early miscarriages as a result of exposure to some chemicals.

Exposure to some chemicals can lead to *mutagenic effects* in both males and females. A mutagenic effect is a permanent change (mutation) to the genes or chromosomes in the female ovum (egg) or male sperm. The mutated gene(s) may be passed on to offspring and result in birth defects.

A birth defect may also be a *teratogenic effect*. A teratogenic effect occurs when the mother is directly exposed to a chemical during pregnancy. The chemical exposure can affect the developing embryo causing damage.

Lead, mercury, ethanol, and ethylene oxide are examples of the many chemicals that pose reproductive hazards. In addition, mumps and rubella (measles) are examples of biological (viral) reproductive hazards.

## BIOLOGICAL HAZARDS

Biological agents may be a part of the total environment or may be associated with certain occupations, such as agriculture. Biological agents in the workplace include bacteria, viruses, fungi, rickettsiae (organisms that cause disease), and parasites of various types. Diseases can be transmitted from animal to man. Infections and parasitic diseases may also result from exposure to insects or by drinking contaminated water. Exposure to biohazards may seem obvious in occupations such as nursing, medical research, laboratory work, farming, and handling of animal products (slaughterhouses and meat packing operations). However, workers on hazardous waste sites may also be exposed to biological hazards.

Biohazards may be transmitted to a person through inhalation, injection, ingestion, or physical contact. Many plants and animals produce irritating, toxic, or allergenic (causing allergic reactions) substances. For

example, histoplasmosis, a lung disease contracted from pigeon droppings, is a serious exposure risk for hazardous waste workers. Workers involved with demolition of abandoned buildings on hazardous waste sites are at highest risk.

Dusts may contain many kinds of allergenic materials, including insect scale, dead skin, hairs, fecal dust, sawdust, plant pollens, and fungal spores. Other hazards include bites or attacks by domestic and wild animals. Laborers on some hazardous waste sites risk exposures to bites from venomous snakes or poisonous spiders.

The effects of biological hazards can range from mild skin irritation to life-threatening viral or bacterial diseases, such as rabies or malaria. Two of the most common symptoms associated with biological hazards are intestinal upset and skin irritation or infection.

Sometimes medical waste that has been dumped or improperly disposed of may be encountered during hazardous waste work. It is important to notify the supervisor if this type of waste is encountered. Specific instructions on handling medical wastes can then be given and followed.

## **ERGONOMIC HAZARDS**

The word ergonomic is derived from the Greek word meaning “the study of work.” Ergonomic principles involve the way that workers interact with their workplace. This includes:

- How workplace conditions (heat, light, noise, weather) affect a worker’s performance.
- The way workers use their tools and equipment.
- How well the overall set up of the workplace fits workers’ abilities and limitations.

The human body can endure considerable discomfort and stress. It can also perform many awkward and unnatural movements for a limited time. However, continuing these movements for long periods of time may

exceed the physical limitations of the worker. Current trends in analyzing ergonomic hazards in the workplace have focused on two areas:

1. Lifting injuries – Musculoskeletal stress from material handling problems (sprains and strains).
2. Cumulative trauma – Musculoskeletal stress associated with operations that create cumulative trauma (tendonitis, carpal tunnel syndrome, and ganglion cysts).

### **Lifting Injuries**

Other ergonomic hazards include manual handling of objects and materials where lifting and carrying is done. Lifting is so much a part of many everyday jobs that most people do not think about it. But lifting is often done incorrectly, with unfortunate results, such as pulled muscles or disk injuries.

Approximately 8 out of 10 people will experience back pain in their lifetime. Back injuries account for 30% of all work-related injuries and result in 18 million doctor visits a year. These injuries represent billions of dollars in medical costs and lost time dollars. Proper lifting techniques, good nutritional habits, muscle tone, weight management, stress management, and avoiding the use of tobacco products help prevent back injuries.

### **Cumulative Trauma**

Cumulative trauma disorders (*CTD*) occur when job demands exceed the physical abilities of the worker. They are also referred to as repetitive motion disorders. *CTD* may cause injury to muscles, tendons, nerves, joints, blood vessels, or ligaments, leading to inflammation, restriction of movement, and specific disorders of joints, muscles, or other body parts.

Vibration also contributes to the development of *CTD*. More than 8 million workers in the U.S. are exposed to vibration hazards on the job, including construction workers. Workers who use chain saws, pneumatic tools, and vibrating electric tools throughout the work shift are at risk. According to the National Institute for Occupation Safety and Health (*NIOSH*), an estimated 1.5 million workers who use vibrating tools may experience

injuries to their fingers, hands and arms. Symptoms of vibration-induced health problems affecting the fingers include:

- Numbness
- Pain
- Whiteness of the fingers
- Loss of finger movement and coordination

This syndrome is often called “white finger disease” or Raynaud’s disease. Stonecutters who used their hands to guide the cutting tool called this injury “dead fingers.”

Whether a worker develops a hand-arm vibration problem depends on several factors:

- The amount of vibration the tool causes
- The length of time a worker uses the tool per day, as well as the cumulative amount of time per month or year
- Environmental conditions (cold or hot weather)
- The worker’s tolerance to vibration
- A worker’s use of tobacco, alcohol, or drugs

Another injury that some workers experience is called carpal tunnel syndrome. It occurs when repetitive and stressful wrist motion causes irritation, fluid build-up, or thickening of the carpal ligaments in the wrists. This condition puts pressure on the nerve and causes pain. Continued use of the wrist under these conditions results in permanent damage to the nerve.

## **PHYSICAL HAZARDS**

Physical hazards may be defined as those hazards that are the result of harmful levels of energy that could cause injury to your body. Examples of physical hazards include:

- Temperature extremes
- Noise
- Radiation

**Temperature  
Extremes**

Extreme temperature conditions can affect the health of workers and their ability to safely perform their tasks. Knowing the signs and symptoms of heat stress and cold stress can help workers prevent injury.

**Heat Stress**

Heat stress is a major physical hazard on a hazardous waste site and can occur without warning. It ranges in severity from heat rash and muscle cramps to heat exhaustion and heat stroke. Several factors contribute to heat stress:

- Environmental conditions
- Clothing
- Workload
- Worker's susceptibility

The chance of developing heat stress increases with increased humidity, hot environments, and the use of PPE. Since heat stress is one of the most common and serious illnesses at hazardous waste sites, regular monitoring and other precautions are essential.

The body maintains a normal temperature (98.6°F/37°C) in a hot environment by sending more blood to the skin and through sweating.

Initially the body cools itself by sending more blood to the skin where heat is released. As the blood vessels dilate to allow more blood to go to the skin, the amount of blood available to other parts of the body decreases. This includes the brain and muscles. Workers in hot environments may feel tired sooner and be less mentally alert. Both these factors, plus the awkwardness from wearing PPE, contribute to an increased number of accidents in the workplace.

As the air temperature increases, the body starts to sweat. Heat is carried away as the sweat evaporates from the skin. If the humidity in the air increases or if the sweat can't evaporate because of PPE, the body has more difficulty keeping a safe temperature. When individuals are severely stressed by the heat, they may stop sweating. The lack of sweating indicates a

breakdown in the body's temperature regulator. This breakdown can result in the most severe form of heat stress—heat stroke.

Adequate rest periods, drinking large amounts of replacement fluids, and frequent monitoring are essential to prevent the consequences of heat stress.

### *Monitoring for Heat Stress*

A worker can reduce the risk of heat stress by regularly monitoring pulse, body temperature, and weight loss.

- Check heart rate (pulse) during rest breaks. If it is greater than 120 beats per minute, work time should be reduced and rest time increased.
- Check temperature at the end of the work period but before drinking fluids. If it's higher than 99.6°F (37.6°C), work time needs to be reduced and rest time increased. If it's higher than 100.6°F (38.1°C), PPE needs to be removed.
- Check weight (in the nude) before and at the end of the work shift. If the weight loss is greater than 1.5% of total weight, more fluids need to be taken in during work (Figure 3-5).

It's also important to check others and yourself for signs and symptoms of heat stress (Table 3-1). Seek treatment if needed.

*To calculate 1.5% of weight:*

Normal weight = 200 lbs.

1.5% = .015

200 lbs x .015 = 3 lbs.

Drink more fluids if weight loss is greater than 3 lbs from the start of the work shift to the end of the work shift.

**Figure 3-5.** Calculating 1.5% of Weight

**Table 3-1.** Signs and Symptoms of Heat Stress

<b>Types of Heat Stress</b>	<b>Cause</b>	<b>Signs/Symptoms</b>
Heat rash	Heavy sweating when sweat is not easily removed by skin evaporation.	Redness on skin Blisters or a rash
Heat cramps	Heavy sweating with inadequate electrolyte replacement.	Muscle spasms Pain in hands, feet, and abdomen
Heat exhaustion	Increased stress on various body organs and the circulation system. Caused by the inability of the the heart to work properly and/or dehydration.	Dizziness Nausea Normal to low temperature Heavy sweating Pale, cool, moist skin Rapid pulse and breathing Fainting
Heat stroke	Heat stroke is the most serious form of heat stress. Temperature regulation fails. Body temperature rises to critical levels, as high as 108° to 112°F. The body must be cooled immediately before serious injury or death occurs. Competent medical help must be obtained.	Dizziness, confusion Nausea High fever Little or no sweating Red, hot, usually dry skin Strong, rapid pulse Convulsions Coma Death

*Individuals at Risk of Heat Stress*

Some workers may be at risk of heat stress because they are:

- Wearing protective clothing.
- Dehydrated from diarrhea or fever caused by infections.
- Physically unfit or have not worked in a hot environment in the preceding week (not acclimated).
- Inflicted with chronic disease, such as heart disease or diabetes.
- Dehydrated from drinking alcohol excessively or using drugs.
- Overweight.
- Regularly taking certain medications for depression, nervous conditions, high blood pressure, diabetes, or heart disease.

*Actions Employers Should Take to Prevent Heat Stress*

Employers should take the following actions to help prevent heat stress:

- Schedule adequate rest periods.
- Provide shaded, and if possible, air-conditioned rest areas.
- Provide cool fluids to drink.
- Provide medical screening, including vital signs.
- Restrict activities.
- Provide adequate first-aid facilities for treatment of heat stress illness.

**Note:** It is **not** recommended that workers take salt tablets to replace the salt lost through sweating. A normal diet contains more than enough salt.

*Actions Workers Should  
Take to Prevent Heat  
Stress*

Workers should take the following actions to prevent heat stress:

- Drink 1.5 gallons (4-6 liters) of fluids (water or juices) during the day, even when not thirsty. Alcohol, coffee, soda, and tea are not good fluids to replace water loss.
- Maintain good physical fitness. Work cautiously until the body has adjusted to the heat (become acclimatized).
- Recognize the signs and symptoms of heat stress.
- Monitor pulse, temperature, and weight.
- Check with the doctor if chronic health problems exist, or if medication is being taken.

If a worker experiences signs or symptoms of heat stress while working, he/she should stop work immediately and notify a supervisor or appropriately trained emergency personnel. If a co-worker or buddy shows or complains of heat stress symptoms, notify the appropriate person.

*Evaluating Heat Stress  
Potential*

Heat stress potential is monitored by using the Wet Bulb Globe Temperature Index (WBGT) developed by the American Conference of Governmental Industrial Hygienists. A workplace competent person, safety or industrial hygiene technician, or medical professional monitors heat stress conditions. Using the WBGT Index, this person evaluates conditions in order to establish worker rest/work schedules.

*Cold Stress*

When air temperatures go down, the body maintains its temperature by reducing blood flow to the skin. This causes a marked decrease in skin temperature. The most extreme effect is on fingers, toes, ear lobes, and nose. Cold hands and fingers become numb and insensitive, leading to an increased possibility of accidents. If the restriction of blood flow to the skin does not maintain body temperature, then shivering occurs. (Shivering generates heat in the muscles.) If shivering doesn't warm the body, then a marked decrease in body temperature may occur. If body temperature drops below 96°F, the condition is called hypothermia.

There are several harmful effects of cold stress:

- Frostbite – The fluid surrounding the tissue cells of body freezes, causing freezing of other body parts. Fingers, toes, ear lobes, and the nose are especially susceptible to frostbite. The first warning is a sharp, pricking sensation. However, the numbness caused by the cold increases the chance of frostbite occurring without warning. Injuries vary from redness of the skin and numbness to loss of skin and loss of body part(s).
- Immersion foot (trench foot) – The skin is injured from long exposure to cold combined with dampness or contact with water. There is no freezing. Injuries vary from swelling, tingling, itching, and pain to loss of skin and skin ulcers.
- Hypothermia – The body is unable to maintain its core body temperature of 98.6°F. Hypothermia can lead to hallucinations, sleepiness, irregular heart beat, unconsciousness, and death.

*Individuals at Risk of  
Cold Stress*

Some workers may be at risk of developing cold stress because they are:

- Wet from sweating or contact with water.
- Doing heavy labor and become fatigued.
- Taking sedatives or drinking alcohol before or during work.
- Inflicted with chronic diseases that affect the heart or blood vessels of the hands or feet.
- Physically unfit or have not worked in a cold environment recently.
- Using pavement breakers or other vibrating equipment.
- Performing tasks in high humidity and/or high winds.
- Inadequately dressed.
- In contact with metal and/or wet surfaces.

*Preventing Cold Stress*

Workers should take the following actions to prevent cold stress:

- Wear several layers of loose fitting dry clothes that can be adjusted to match changing temperatures. A top layer of wind-proof clothing is useful in the wind.
- Do **not** become overheated and sweaty.
- Keep extremities warm and check for numbness.
- If chills, sleepiness, or pain and cold in the extremities develop, go to a warm shelter.
- If any chronic heart or blood vessel disease exists, avoid working in cold weather.
- Do **not** use sedatives or drink alcohol excessively. See a doctor if there are any questions.
- Cover the head. The body can lose up to 40% of its heat when the head is uncovered.

**Noise**

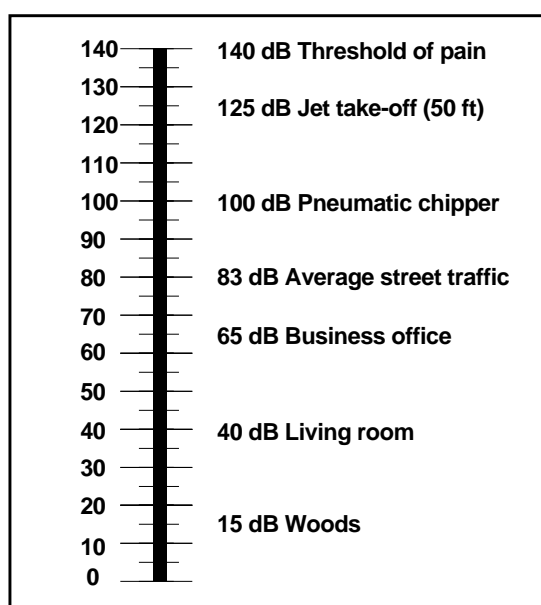
Noise is any undesired sound that interferes with the perception of wanted sound. It is likely to be harmful, annoying, and/or interfere with speech. Noise is a hazard when it results in the following conditions:

- Temporary or permanent hearing loss
- Physical or mental disturbance
- Interference with voice communications
- Disruption of a job, rest, relaxation, or sleep

The most common effect of hazardous noise is hearing loss. Other health effects associated with noise and its resulting stress include:

- Heart disease
- Stomach and bowel disorders
- Stress and nervous tension
- Vision and balance disturbances
- Stroke
- Headaches

The loudness or softness of sound is determined by intensity or sound pressure. The more power driving the sound, the higher the pressure. This is measured with an instrument called a sound level meter (*SLM*) in units called decibels (*dB*). Sounds that can just be heard by a person with very good hearing in an extremely quiet location are assigned the value of 0 dB. Ordinary speech is around 50 to 60 dB. At about 120 to 140 dB, the threshold of pain is reached. This level of sound is like hearing a jet engine while standing about 50 feet away. Figure 3-6 shows decibel levels for common noises.



**Figure 3-6.** Decibel levels for common noises.

### Biological Effects of Noise Exposure

Although there are many causes of hearing loss, the major cause of damage is excessive occupational noise. Twenty million Americans experience hearing loss as a result of occupational noise exposures. Off-the-job noise exposures, such as to motorcycles, snowmobiles, and airplanes, can also cause hearing loss.

The outer and middle ear are rarely damaged by exposure to intense sound energy, although explosive sounds or blasts can rupture the eardrum and possibly dislodge the small bones in the middle ear. Work-related hearing loss is most often caused by excessive noise that involves injury to the cilia of the inner ear.

Early signs of hearing damage include a loss of hearing in the higher frequency range. This happens because the first cilia to be destroyed are the ones that transmit high frequency sound. So although an individual can still hear sound, speech and other high frequency sounds, like music, are distorted. A high frequency sound like the letter “s” cannot be heard but a low frequency sound like “o” is no problem. Initially, this may be a temporary threshold shift (temporary hearing loss) with recovery in about 14 hours.

Exposure to intense noise causes hearing losses that may be temporary, permanent, or a combination of both. Such losses may occur after only a few minutes of exposure to intense noise. The greatest portion of temporary hearing losses occur within the first two hours of exposure. Recovery from such losses is usually within one or two hours after being removed from the noise exposure. Further exposure may result in a deepening and widening of the loss. This hearing loss will involve the speech frequency range resulting in considerable difficulty in hearing conversational speech. As noise-induced hearing loss progresses, first, the individual will be unable to hear plurals. Next, it will be difficult to distinguish between two words like fifteen and sixteen. Finally, it will not be possible to understand what people are saying, even though it is possible to hear that they are talking.

Noise-induced hearing loss may also cause continual ringing in the ears. This is called tinnitus and can be very stressful.

Workers who have been exposed to high noise levels daily for a period of many years experience permanent hearing loss. Permanent hearing loss follows a similar pattern as temporary hearing loss, except it's permanent and there is no known treatment or cure.

To measure hearing loss, a baseline of the hearing ability is established by conducting hearing tests (audiometer tests). Retests are taken at a later time, usually one year, and the results are compared to the baseline. Hearing loss may occur with varying degrees of loss in each ear.

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## Workplace Noise

Workplaces are required to have noise exposure limits to minimize hearing loss from occupational exposure.

Although louder noise may be allowed for brief periods during the workday, OSHA set the permissible exposure limit (*PEL*) for noise at 90 dBA, time weighted average (*TWA*) over 8 hours. The action level for noise is 85 dBA *TWA*. At this level the employer must:

- Make hearing protection available
- Provide training on hearing conservation
- Provide hearing tests

Over 90 dBA, employers must ensure that hearing protection is being used along with training and hearing tests. Studies have shown that in most individuals injuries are likely to occur at 90 dBA. It is important to know that every 5 dB doubles the sound intensity. In other words, 90 dB is twice as loud as 85 dB. Thus, as the noise levels increase, the time spent in the noisy area should decrease.

The communication problems caused by hearing loss are very frustrating and easily misunderstood by co-workers, family, and friends. A person may appear to hear very well at times and poorly at other times. It is important for workers to understand the potential for this kind of communication problem on construction sites and ensure that their co-workers hear everything that is said.

## Protective Equipment

When it isn't possible to eliminate noise above 85 dBA, workers should wear hearing protection. Hearing protection is considered to be a last resort if other controls are not possible. One example of a control is enclosing or isolating the noise source.

Hearing protection reduces sound intensity to varying degrees (from 5dB to 12 dB), depending on the type and manufacturer. Labels on hearing protection carry a noise reduction rating (*NRR*) that may be up to 30dB to 40dB. Ear plugs or ear muffs are examples of hearing protection. Ear muffs provide about the same level of protection as ear plugs. They are heavier and hotter to wear than ear plugs, and must be securely positioned over the ears without interference from hair or glasses.

Hearing protection must be worn properly to get maximum protection. Ear plugs must be firmly inserted into the ear canal. Generally, the ability to hear speech is not drastically reduced by hearing protection. Workers should wash their hands before inserting ear plugs to prevent dirt and grease from getting on the plugs. Dirty ear plugs can contaminate ears.

## **Radiation**

Exposure to radiation has risks. There is heated debate and differing opinion about the risks of radiation exposure, the acceptable level of risk, and appropriate exposure limits. The exposure of living tissue to ionizing radiation has harmful effects, including damage or death to the cell. The extent of damage is dependent upon the radiation dosage and the organs exposed. Some organs are more susceptible to radiation than others, for example bone marrow and the gastrointestinal tract. The effects of low dosage radiation are delayed and may be detectable only by medical surveillance.

### **Nonionizing Radiation**

Nonionizing radiation is generated by such things as the sun, lamps, welding arcs, lasers, plastic sealers, and radio or radar broadcast equipment. Although nonionizing radiation is not as hazardous as ionizing radiation, there are exposures that can cause severe injuries. Since the eye is a target organ for all types of nonionizing radiation, eye protection is very important. Protective glasses should be selected based on the type of radiation exposure (e.g., sun light, welding flashes).

### **Ionizing Radiation**

During site characterization, surveys are conducted for three types of ionizing radiation:

1. Alpha
2. Beta
3. Gamma

Alpha emitting radioactive material is primarily an internal hazard. This internal hazard exists if alpha emitting radioactive material is inhaled, ingested, or absorbed through broken skin. Protective clothing should be used to prevent contamination of the skin.

Beta emitting radioactive material is both an internal and external hazard. Externally it damages the skin and eyes. Internally it damages any tissue it touches. Skin burns may result from excessively high doses of beta radiation.

Gamma radiation has the ability to penetrate completely through the body, and is both an internal and external hazard.

#### Health Effects of Radiation

Ionizing radiation causes both acute and chronic health effects. prompt effects are seen immediately and range from mild effects at low exposure concentrations, up to and including death at high concentrations. Acute exposures to radiation are rarely seen on hazardous waste sites and usually are due to unforeseen accidents or releases. delayed effects are usually seen from low exposures over a long period of time.

#### **MEDICAL MONITORING**

Medical monitoring helps to determine a worker's physical condition and whether any chemical exposures have occurred. Workers may see a doctor for any one of several reasons. Similarly a doctor may order medical tests for several different reasons:

- Sickness, weight loss, or constant fatigue (tiredness).
- Disease prevention, routine physical, or blood cholesterol level check – If the results are abnormal, medication or a special diet may be prescribed to prevent a stroke or a heart attack.
- For early diagnosis – If results from tests done during the routine examination indicate problems, the doctor may be able to detect and diagnose a disease early in its course, allowing for a better chance for a cure.

#### **Limitations of Medical Testing**

The medical testing required for being a hazardous waste worker will likely be job specific. OSHA regulations allow the examining doctor to determine most of the content of the examination. (The exam content is discussed in 29 CFR 1910.120 (f)) The benefits received from an examination will vary with the content of the

examination. No matter what the examination consists of, it must be understood that there are certain important limitations of medical testing.

- Medical testing cannot prevent cancer. Cancer from exposure to chemicals or asbestos can only be prevented by reducing or eliminating an exposure.
- For many conditions, there is no medical test for early diagnosis. For example, routine blood tests for kidney function do not show abnormal results until half of the kidney function has been lost. Nine out of 10 people with lung cancer die within five years because chest x-rays do not show lung cancer early enough to save the individual.
- No medical test is perfect. Some tests may show falsely normal or abnormal results.

### **Common Medical Tests**

Workers undergo several different medical tests in preparation for working on a hazardous waste site as well as during the cleanup. (See Appendix 3-3 for frequency of medical testing.) These tests include:

- Questionnaire
- Physical examination
- Laboratory tests
- Pulmonary function tests
- Electrocardiogram
- Chest x-rays
- Hearing tests

### **Questionnaire**

Despite common perceptions, a worker's medical and work history is probably the most important part of the examination. Most diagnoses of disease are made by evaluating the patient's history. Laboratory tests are used to confirm the impression from the history. The doctor will be interested in a history of lung, heart, kidney, liver, and other chronic diseases. The doctor will also be concerned about symptoms indicating heart or lung disease not previously diagnosed.

**Physical Examination**

A physical examination is very beneficial for routine screening. The exam includes procedures such as:

- Checking blood pressure and pulse
- Inspecting the skin for lesions
- Evaluating neurological signs, such as hand strength and reflexes
- Listening to the heart and lungs with a stethoscope
- A general physical assessment by the doctor

Normal findings during the physical exam are important. However, occasionally an individual has a serious medical problem, even though the physical examination results seem perfectly normal.

**Laboratory Tests**

Blood is taken to check for blood cell production (anemia), liver function, kidney function, and if taken while fasting, for increased sugar, cholesterol, and fat in the blood. Because chemical exposures at sites are usually below the levels causing changes in these results, the tests results are usually normal.

Urine tests are taken to check for kidney function and diabetes (sugar in the urine). Usually these results are normal. It's also possible to determine the presence of chemicals in the body from blood and urine tests. If the laboratory procedure used to measure the chemicals is sensitive enough, these tests may be the most helpful. The tests are called biological monitoring. They help to determine whether workers are being adequately protected against chemical exposure.

**Pulmonary Function Tests**

A pulmonary function test (*PFT*) measures the lungs' vital capacity. An individual forcibly exhales into a machine that measures the amount of air inhaled and how quickly the air is exhaled. A PFT is useful for diagnosing diseases that cause scarring. These diseases affect how much the lung can be expanded and the ability to inhale and exhale. A PFT is also useful for evaluating whether a worker with breathing symptoms can wear a respirator without additional health risk.

**Electrocardiogram**

An electrocardiogram (*ECG* or *EKG*) helps diagnose the presence of irregular heart beats as well as any damage that may have occurred in the heart muscle in the past.

Construction and hazardous waste site work can be extremely strenuous, particularly when wearing PPE in hot weather. A stress test is conducted to determine a worker's fitness level and if the questionnaire shows a high risk of having heart disease. The test involves having a worker wear an ECG while exercising.

#### Chest X-Ray

Chest x-rays help to determine the cause of breathing problems in individuals with symptoms. An x-ray is used to screen for lung scarring from exposure to asbestos or silica. It should not be performed routinely, unless the history indicates a potential lung or heart problem, and the doctor thinks a chest x-ray would be necessary.

#### Hearing Tests

An audiometer is a frequency-controlled, audio-signal generator that measures hearing ability. It produces pure tones at various frequencies and intensities for measuring hearing sensitivity. To measure the hearing threshold, the worker's ability to hear the simplest form of sound (called pure tones) must be determined.

After a hearing test has been done, hearing loss is plotted on a chart (audiogram) to produce a profile of a person's hearing. A trained person reviews the audiogram to determine the type and degree of hearing loss, and estimates the communication difficulty this loss will cause. After a baseline hearing test has been obtained, follow-up tests can detect hearing loss between tests. Hearing losses may indicate that hearing protection has been used improperly or not at all. Consequently, the person experiences a hearing loss.

#### **Important Points to Remember**

The following list highlights some points to remember regarding medical monitoring:

- Preventing exposure to chemicals is better at preventing disease than medical testing.
- A normal medical examination is no assurance that current work exposures won't make a worker sick in the future.
- A work and medical history is important in determining the need of additional medical testing.

- If a worker is not feeling well or is having continued symptoms, he/she should seek medical attention, regardless of previous test results.

## **GENERAL PROTECTIONS**

To avoid unnecessary exposures caused by careless personal hygiene, workers should do the following:

- Remove contamination and/or irritants from the skin as soon as possible.
- Make sure to wash work clothing separately from the rest of the wash at home.
- Read and understand the material safety data sheets (*MSDSs*) that indicate potential exposures.
- Wash hands thoroughly before eating, drinking, or smoking. Five seconds of washing with soap and water removes 90% of contaminants.

## **OVERALL HEALTH CONCERNS**

On average, construction workers die 8 to 12 years earlier than workers in other industries. The four leading causes of on-the-job deaths for LIUNA members are:

1. Struck by (e.g., a moving vehicle or falling object) – 47% of LIUNA occupational fatalities.
2. Caught in or under (e.g., trench cave-in) or caught between (e.g., motor vehicle and fixed barricade) – 27% of LIUNA fatalities.
3. Falling from heights (e.g., scaffold) – 21% of LIUNA fatalities.
4. Electrocutions – 4% of LIUNA fatalities.

Heart disease is the number one killer of male members over age 40. Cancer is the number two killer of males over the age of 40. Nationally, AIDS is the number one killer of men ages 25-44 and number three for women ages 25-44.

The Laborers' Health and Safety Fund of North America supplies hand-outs on the above and other health issues. They are available from the instructor.

**DRUG TESTING**

Today, the construction industry, as well as most other industries, require workers with more than just strong backs. More and more, Laborers and other workers must use intelligence and skills to work more safely and efficiently. Also, today's worker must be physically and mentally fit for duty. The majority of companies have drug-free workplace policies and may have to comply with federal regulations. Therefore, fit for duty on most job sites means being drug and alcohol free. This includes sites owned or controlled by the Department of Energy (*DOE*). As an organization, LIUNA has a firm commitment to work site safety and improving the health of its members and their families. One aspect of this commitment is educating members, union representatives, signatory contractors, and others on the health dangers and consequences of substance abuse.

**Testing in the Workplace**

Today, over 50% of workers nationwide are subject to drug and/or alcohol testing at the work site. In 1994, an estimated 87% of the major US companies were conducting some form of pre-employment and/or employee testing. This number continues to climb each year. For LIUNA members, testing is often required by signatory contractors, government agencies, or owners as a condition of working on certain job sites. Data from almost ten years of workplace drug screening programs show a significant reduction in positive test results. In 1987, SmithKline Beecham Laboratories, a national drug testing laboratory, reported an overall 18.1% positive rate for workplace drug tests. In an analysis of 3.6 million samples for the year 1994, SmithKline reported an overall positive rate of 7.5%.

Many LIUNA members may work on job sites that are covered by federal regulations requiring drug and/or alcohol testing. Examples include:

- Department of Transportation (*DOT*) – Includes workers engaged in “safety-sensitive” job duties. Examples are pipeline maintenance workers, highway resurfacing and maintenance workers, operators of vehicles over 26,000 lbs who possess commercial driver's licenses, and related support functions.

- Workers on hazardous waste, environmental cleanup or nuclear sites as regulated by the DOE or the Nuclear Regulatory Commission (*NRC*).
- Workers on “safety sensitive” jobs performed by contractors for the Department of Defense (*DOD*).

Recently, there has been an effort to include alcohol in the drug testing procedures for some workers covered by federal regulations. Given this fact, it’s unlikely that drug testing will be stopped in the near future. Many experts feel that efforts to include alcohol and a wider selection of drugs will continue and eventually be successful. In fact, many companies not covered by federal regulations but who drug test as a matter of company policy, test for drugs not now included in what is referred to as the NIDA 5. (NIDA 5 refers to the five drugs tested for under federal regulations: marijuana, cocaine, opiates, amphetamines, and PCP).

**It is critical that workers know the following information:**

- Types of drug and alcohol tests
- What drugs will be tested for
- Procedures that should be used in the testing process
- Health effects of various drugs
- What happens if a test is positive
- Where a worker with problems can get help

**Note:** DOE training sites - see Appendix 3-4.

**Types of Drug and Alcohol Testing**

The grounds for work site drug or alcohol testing may depend on various factors:

- Whether the job or workplace is subject to federal regulations.
- What the union and employer negotiate as reflected in contract language.
- What the employer/owner’s policy requires.

Drug or alcohol testing may be required in several circumstances. Workers may be subject to the following types of drug or alcohol testing:

- Prejob or preplacement
- For Cause or Reasonable Suspicion
- Post-accident
- Random
- Return to duty and follow-up

#### Prejob or Preplacement Testing

Prejob or preplacement testing is often required before a worker is hired, allowed access to the property, or allowed to perform certain duties. Sometimes these tests will be administered during a probationary period. This is the most common type of testing done in construction, manufacturing, and service sector jobs.

#### For Cause or Reasonable Suspicion Testing

For cause or reasonable suspicion testing is conducted if an employer has reason to believe a worker is:

- Using, possessing, or trafficking in drugs
- Impaired by drugs or alcohol

Cause should be based on specific and verifiable events, appearance, or behavior, such as observed possession, trafficking, distribution, or use of a prohibited substance on company property or job sites.

Reasonable suspicion can include a combination of physical or performance related actions. Examples include chronic absenteeism, decreased job performance, and increased mistakes.

Policies that include for cause or reasonable suspicion testing typically provide 1-2 hour training sessions for those supervisory individuals charged with the responsibility for determining who will be tested.

#### Post-Accident Testing

Depending on the policy or applicable regulation, an accident may be defined as an incident that results in damage to property (with a specific dollar threshold) or as a result of a workplace or job site injury requiring medical attention. The Department of Transportation regulations have specific rules for post-accident procedures, which include abstaining from alcohol use for up to 8 hours after accidents.

**Random Testing**

The purpose of random testing is to deter casual use. While required under some federal regulations, random testing is not as common as pre-employment testing in the private sector.

Random testing should not be confused with periodic testing which is selecting a specific individual to be tested at a specific time without cause or without a random selection process.

During random testing, all members in a random testing pool have an equal chance of being selected for a random drug or alcohol test at any time. Most random testing procedures require the selected individual to report to the designated collection site within two hours of notification of selection. Even after an individual is selected and tested, that individual remains part of the testing pool of workers to be drawn from. Therefore, it is possible some workers in a random testing pool could be tested several times in the course of a year while others would not be selected.

**Return to Duty and Follow-Up Testing**

Return to duty and follow-up testing applies to workers who may have previously tested positive, been referred to treatment (rehabilitation), and are returning to duty. This type of testing may be done for workers in jobs classified as safety-sensitive under federal regulations.

It can also apply to workers returning to work sites after an extended period of absence.

**Drugs Tested**

Federal regulations specify which drugs can be tested for. DOT specifies alcohol and the NIDA 5. DOE says the NIDA 5 drugs must be tested for, but a worker may be tested for any controlled substance. NRC specifies the NIDA 5, but says additional drugs can be tested for with permission from the agency. Company policies might include the basic five drugs plus benzodiazapines (tranquilizers), barbiturates, propoxyphene (Darvon), methadone, or any other controlled substance, as well as alcohol.

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**THE TESTING PROCESS**

The urine drug testing process includes four steps:

1. Collection
2. Initial screening
3. Confirmation
4. Verification

**Collection**

If the job site or the testing procedures are federally regulated, the sample collection and testing facilities must follow specific federally designated procedures entitled “Mandatory Requirements for Workplace Testing Programs.” Federal procedures are known as the “gold standard” for workplace testing programs. However, federal procedures are not mandatory unless required by federal regulations. If testing procedures aren’t subject to federal regulations, the procedure used will either be negotiated by the union or at the discretion of the employer and/or collection facility.

The sample collection and handling procedures are called the chain of custody. The process includes these steps:

1. Worker provides a urine sample in a cup. The sample is normally given in privacy, but the collection site may use procedures to ensure the sample’s integrity, such as:
  - No water in the sample stall
  - Bluing agent in toilet water
  - Removal of excess clothing, etc., to minimize sample substitution or adulteration
  - Direct observation of the individual giving the sample (not common)

If the testing is DOT regulated, the sample must be split into two parts. One part is used for testing. The other part is stored in case the results of the first test must be verified. (If the testing is not DOT regulated, a worker may request a split sample for future protection.)

2. A collection agent (employer or lab personnel) takes the sample immediately. The sample’s temperature is checked to make sure it’s a recent void and not diluted or adulterated. This step is required in federally regulated testing.

3. The individual signs/initials a label or seal for use in sealing the sample's container.
4. The collection agent seals the sample(s) in the presence of the worker. The worker signs a chain of custody form or log stating who received the sample(s) and acknowledging the sample was sealed in his/her presence. The chain of custody form stays with the sample until it gets to the lab. Each person who handles the sample signs the form to ensure a valid chain of custody.

**Note:** The sealing process is extremely important to ensure the validity of the chain of custody until the sample arrives at the testing laboratory. (It serves to minimize disputes over adulteration and mislabeling.) It is required under federally regulated testing.

5. The sample is forwarded to a laboratory for testing. Most employers use testing laboratories that are certified by the federal government. These laboratories are rigorously inspected and subjected to continuous quality assurance checks. The use of federally certified laboratories is recommended to avoid liability from inaccurate test results. When the sample arrives, lab personnel conduct initial tests to make sure the sample is valid and hasn't been tampered with (i.e., added fluids, adulterants, etc.).
6. Once the sample is determined to be valid, the testing process begins.

### Initial Screen

An initial screen (immunoassay test) is used to detect the level of metabolites at specific cut-off levels for each drug. (Figure 3-7 shows federal cut off levels.) Metabolites are the by-products (what is left over) of drugs as they pass through the body. If the sample is below the cut-off level, the lab reports back that the result was negative and all samples (including the split sample in storage) are disposed of.

If the result is at or higher than the cut-off levels, a confirmation test of the same sample is conducted using a more accurate test known as gas chromatography/mass spectrometry (*GC/MS*). *GC/MS* is considered 100%

### WORK SITE SUBSTANCE TESTING

Drug or Category	Alcohol	Marijuana	Cocaine	Amphetamine	Opiates	PCP	Others
Average Detection Time after Ingestion	3-8 hrs.	3 Days to 3 Weeks	2-4 Days	1-2 Days	2 Days	Up To 8 Days	1-4 Days* *
Initial Cut-off Levels (by immunoassay)	.02 BAC	50 ng/ml	300 ng/ml	1000 ng/ml	300 ng/ml	25 ng/ml	no Federal standards
Confirmatory Cut-off Levels (by GC/MS)	.04 BAC	15 ng/ml	150 ng/ml	500 ng/ml	300 ng/ml	25 ng/ml	no Federal standards
% of 1994 Workplace Positive Test Results*	N/A	47%	24%	4%	6.7%	>1%	15%* * *
Legal/Legitimate Uses	Yes	Rare	Rare	Rare	Yes	None	Yes

\*As provided by SmithKlein Beecham's 1994 report of a 7.5% positive test rate from samples tested at six NIDA certified labs nationwide.

\*\*Benzodiazapines (tranquilizers) 3 days; Barbiturates 3 days-3 weeks; Propoxyphene (Darvon) 2 days; Methadone 3 days

\*\*\*Benzodiazapines (tranquilizers) 10.2%; Barbiturates 4.5%; Propoxyphene (Darvon) 1.8%; Methadone 1.8%

**Figure 3-7.** Work Site Substance Testing Chart Showing Cut-Off Levels

accurate (except for human error). GC/MS tests also use cut-off levels to confirm the presence of drug metabolites. If the level of metabolites in the sample measures below the cut-off level, the lab reports the test as negative and all samples are destroyed.

### **Confirmation**

If the metabolite level is above the threshold (or cut-off level), the result is either reported to the employer as positive or forwarded to a medical review officer (*MRO*) for further investigation. Federally regulated drug testing requires the use of an MRO before releasing any positive test results. In nonregulated environments the use of an MRO as a final step is not required, but it is highly recommended to reduce employer liability.

The purpose of the MRO is to determine if legitimate reasons exist for positive test results. For example, the MRO may investigate the following:

- Legitimate use of a prescription drug under a doctor's orders.
- Ingestion of poppy seeds (in the case of a positive opiate result).
- Member concerns about procedural or chain of custody errors.

### **Verification**

Federal regulations provide that the MRO should attempt to review the results of a positive drug test with the individual, if only by telephone, before declaring a test as positive. Usually the MRO has a designated time period for contacting the individual (e.g., 48 hours.) If the MRO cannot contact the individual, a determination is made based on the information at hand. This may result in a verified positive result, unless the MRO finds a problem with the collection or testing procedure, or a suitable explanation (ie; prescribed medication) has been provided by the worker on the chain of custody form. For this reason, it's important for workers to provide information about where they can be reached in the 48-72 hours following a drug test, to enable the MRO to contact them for any necessary information.

If federal procedures and an MRO are not used, the worker tested will likely be notified of the positive test result and consequences by the employer representative.

## **POSITIVE DRUG TESTS AND WHAT THEY PROVE**

**Urine Drug Testing.**— A urine drug screen seeks to identify the presence of drug metabolites in the urine. The presence of metabolites shows that the drug has been ingested by the person providing the sample. Positive metabolite results are measured in units called nanograms (*ng*). The determination that a urine sample is positive is further measured by the cut-off level (the presence of metabolites over a certain limit). Cut-off levels are set to eliminate “false positives.”

The amount of the drug metabolite identified in the sample (the number of ngs) depends on a variety of individual circumstances. For example weight, metabolism rate, or the amount of water or food consumed can affect the amount of metabolites.

A urine drug test indicates the recent use of a particular drug. It does not measure impairment or verify that a worker is under the influence of an illicit drug. It cannot determine how much was consumed or when it was consumed, regardless of the amount of nanograms recorded. Test results should be reported simply as positive or negative, without the number of nanograms. (This information can be obtained from the testing facility with consent of the worker tested.) At DOE sites results must be reported only as positive or negative.

**Alcohol Testing** – Breath alcohol tests performed with a breathalyzer indicate current impairment—known as breath alcohol concentration (*BAC*). Tests results are recorded as a number. A result above a certain level is considered positive. No separate tests are necessary or required for alcohol testing. (However, most testing procedures for drugs include a second test immediately following as a verification.)

This technology has been used by law enforcement agencies for many years and is considered highly accurate. Under some federal regulations, NRC and DOT, a positive BAC can mean removal from safety-

sensitive duty and a prohibition against resuming such duties until a referral to a substance abuse professional for evaluation and possible rehabilitation is completed. The DOT BAC levels (.02 and .04) for these regulations are many times lower than the current state law enforcement levels for driving while intoxicated which range from .08 to .1 BAC. Breath alcohol tests have been proposed but are not yet required for DOE facilities.

**Positives and False Positives** – A positive test result is defined as the presence of a drug metabolite (urine) or alcohol (breath) in the test sample. Some positive test results can have legitimate medical explanations. Individuals who are subject to drug testing should discuss the use of medications and any possible safety concerns with their medical provider. For example, prescribed sleeping or pain medications often contain opiates. Even if taken under a physician's direction, they will cause a positive test result. Certain over-the-counter (non-prescription) cold medicines contain alcohol. They may result in a positive reading if taken prior to a breath alcohol test. Individuals who are using such medications may technically be considered "unfit for duty." In some policies, using prescription medications prescribed for others or without a valid prescription is considered "illicit drug use." Disciplinary action could result if they are detected by a positive drug test.

A false positive is a test result that indicates the presence of a metabolite when there is none present. False positives are extremely rare with today's increasingly accurate testing, retesting, and verification processes, as long as federal (or equivalent) testing and chain of custody procedures are followed. However, the human error factor has not been totally eliminated.

### **Consequences of Positive Test Results**

One of the most important parts of a comprehensive drug testing policy is determining or negotiating the consequences of positive test results. As with other aspects of a policy, sometimes these are specified by federal regulations or owner stipulations. In considering the consequences for positive test results, the need to maintain a strict drug abuse policy must be weighed

against losing an otherwise productive worker. Listed below are some of the common consequences and concerns in these policy situations:

- In pre-job testing situations, the applicant normally will not be hired or cleared for work. Union and employer representatives have considerable leeway in developing a time period after which, or if at all, an individual may be reconsidered for hire.
- For current employees who test positive, disciplinary action up to and including termination may be the result. The action will depend on the policy negotiated.
- For jobs covered by DOT regulations, workers testing positive for drugs or alcohol must be removed from safety-sensitive duties. Current and proposed DOE regulations require the same action. Neither DOT, DOE, or DOD regulations require that a worker be terminated for a positive test result. However, DOE regulations require termination upon a second positive drug test.
- On some work sites, workers who receive positive test results are entitled to opportunities to seek assistance for substance abuse education and or treatment by referral to the Membership Assistance Program (*MAP*), the company's Employee Assistance Program (*EAP*), or a similar community agency. In some cases, this evaluation will be followed by a recommendation for some type of treatment (rehabilitation). If eligible, the worker may use health insurance benefits to obtain the necessary treatment. The worker may return to work after completion of treatment or while using an outpatient treatment setting, depending on the wording of the employer policy.

### **Retesting After a Positive Test Result**

As regulated by certain federal agencies (including DOE), in some states, and in some drug testing policies, workers who wish to contest a positive test result have the right to an independent test. This test is performed on the original sample (the split portion that has been set aside for this purpose), at another laboratory, and typically at the worker's expense. The request for an

independent retest must be promptly submitted. It's often specified by policy (or law) that the request must be submitted within a specified time (i.e. within 72 hours) of the worker's notification of the positive test result. It is also the worker's responsibility to pursue this challenge. Often the laboratory is not required to reserve a portion of the original sample for a retest past the time limit specified.

Sometimes workers who test positive will submit results from a subsequent urine test of a different sample to dispute a positive result received in a workplace testing program. These results are not usually sufficient to discount the results of the original test. Given that test results are essentially a chemical "snapshot" of the level of metabolites in a worker's urine (or alcohol in breath), it is possible for subsequent urine or breath tests to give a different result.

### **Questioning the Accuracy of a Positive Test Result**

A confirmed, verified positive urine drug test result arrived at according to federal standards and procedures is extremely difficult to successfully challenge on the basis of the test itself. Since 1989, the federal government has continued to develop and exercise strict accuracy standards and testing and certification requirements for urine drug testing and sample collection procedures. These standards and requirements have held up in numerous legal challenges. In addition, the current alcohol breathalyzer technology has been used for many years by law enforcement agencies. It is normally considered an accurate measure of recent alcohol use, and in most cases, of impairment. The existing technology is considered accurate and reliable. Challenges to positive test results are most often successful on the basis of the following:

- Legitimate ingestion of the drug
- Problems with the lab equipment
- Handling of the sample
- Potential contamination
- Broken chain of custody

To adequately investigate a disputed positive drug test result, the following information is needed:

- Circumstances of the testing – pre-job, random, post-accident, for cause or reasonable suspicion.
- The prohibited substance that was confirmed positive.
- The methods or procedures used for testing.
- Whether the methods used were in accord with federal guidelines. If not, what were the specifics?
- The specific collection site and laboratory used.
- Whether an MRO was involved and if the worker was contacted to provide an explanation.
- Whether the worker was provided an opportunity to have the sample retested?

The above information can be obtained from the worker tested, employer, and/or the laboratory. Proper authorizations will be needed.

## **WHERE TO GO FOR HELP**

DOE regulations require that contractors advise workers of the assistance available to them. At its 1986 Convention, LIUNA delegates voted on and passed Resolution #IV, entitled Drug and Alcohol Abuse Rehabilitation. The resolution is considered the premise for the Laborers' Member Assistance Programs and states:

“Alcohol and drug abuse are widely recognized as treatable illnesses in current medical and psychiatric practice. Highly successful programs for the rehabilitation of substance abusers have been developed by public and private groups. . . .The recovery rate for participants in many of these programs has reached levels as high as 70 percent . . . . By providing a mechanism for rehabilitation, unions have given their members an alternative to discharge and termination...Substance abuse rehabilitation programs are of proven effectiveness and are the ‘high ground’ on this issue. . .”

Providing assistance to members with substance abuse problems and the often resulting personal problems is the preferred alternative to the “test and terminate” approach practiced in some workplaces. Helping

members by developing and publicizing sources of assistance is a win-win proposition for members, union officials, and employers. Listed below are some sources of such assistance for LIUNA members and their families.

- **Laborers' Membership Assistance Program (MAP)** – The Laborers' Health & Safety Fund of North America is available to provide information, consult with and assist health and welfare funds in establishing these types of programs. Member Assistance Programs are union-funded, typically linked to health benefits, and provide the critical link between members, health care benefits for substance abuse, and a successful treatment experience.
- **Employee Assistance Programs (EAPs)** – Many employers offer this benefit to employees, often in conjunction with behavioral and mental health benefits. These programs are confidential and knowledgeable on issues of substance abuse and chemical dependency treatment. Contact the employer's human resources staff for details.
- **Community resources** – Each of the 50 states has designated two local AFL-CIO Community Services representatives to assist union members and representatives with substance abuse and a host of other personal and family issues. These individuals are knowledgeable and can provide referrals to local social service and United Way agencies.
- **Health benefits** – Many health plans, union or employer provided, include benefits for substance abuse and chemical dependency. Members should familiarize themselves with the plan eligibility rules and treatment coverage in order to make the best choice for assistance.
- **Self-help groups** – Free community resources include Alcoholic Anonymous, Al-Anon, 12 step, and related support groups. Most are listed in telephone directories.

- **National hot lines** – Numerous national hot lines with toll-free numbers exist to allow individuals to obtain information about alcohol and other drugs to educate themselves and other family members.

Check with your local union or benefits office to find out options specific to your area.



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**SECTION 3 - ASSIGNMENT SHEET**

1. Match the following words with the proper definition or example.

- |                         |   |
|-------------------------|---|
| _____ Cancer            | a. Occurs in the body at some place other than    |
| _____ Systemic effect   | the point of contact.                             |
| _____ Dose              | b. Organs affected by a chemical.                 |
| _____ Ingestion         | c. The time between exposure and effect.          |
| _____ Inhalation        | d. Route of exposure (breathing).                 |
| _____ Interaction       | e. A rapid growth or tumor.                       |
| _____ Latency period    | f. Occurs at the site where a chemical makes      |
| _____ Target organs     | contact.  |
| _____ Local effect      | g. An amount (or concentration) over time.        |
| _____ Olfactory fatigue | h. Route of exposure (eating).                    |
|                         | i. The combined effect of chemical exposure and a |
|                         | personal habit, such as cigarette smoking.        |
|                         | j. The sense of smell becomes dulled because of   |
|                         | chemical exposure.                                |

2. Write out the following acronyms.

CTD \_\_\_\_\_  
dB \_\_\_\_\_  
PFT \_\_\_\_\_

3. List three routes of exposure and give two examples of each.

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4. List six warning signs of chemical exposure.

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5. List four forms of heat stress and give the symptoms of each.

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6. List the actions a worker should take to prevent heat stress.

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7. List the actions an employer should take to prevent heat stress in an employee.

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8. List three purposes of medical testing.

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9. Monitor pulse, temperature, and weight.

10. List the circumstances under which a worker may be subject to drug or alcohol testing.

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**APPENDIX 3-1****AGENTS, SUBSTANCES, MIXTURES, AND EXPOSURE CIRCUMSTANCES  
KNOWN TO BE HUMAN CARCINOGENS**

From *The Ninth Report on Carcinogens*, National Toxicology Program (U.S. Department of Health and Human Services, Public Health Service)

Aflatoxins  
Alcoholic beverage consumption  
4-Aminobiphenyl (4-Aminodiphenyl)  
Analgesic mixtures containing phenacetin  
Arsenic and certain arsenic compounds  
Asbestos  
Azathioprine  
Benzene  
Benzidine  
bis(Chloromethyl) ether and technical-grade chloromethyl methyl ether  
1,3-Butadiene  
1,4-Butanediol dimethylsulfonate  
Cadmium and cadmium compounds  
Chlorambucil  
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (MeCCNU)  
Chromium hexavalent compounds  
Coke oven emissions  
Conjugated estrogens  
Cyclophosphamide  
Cyclosporin A  
Diethylstilbestrol  
Dyes that metabolize to benzidine – direct black 38 and direct blue 6  
Environmental tobacco smoke  
Erionite  
Ethylene oxide  
Melphalan  
Methoxsalen with ultraviolet A therapy (PUVA)  
Mustard gas  
2-Naphthylamine  
Radon  
Silica, crystalline (Respirable Size) – quartz, cristobalite, tridymite  
Smokeless tobacco  
Solar radiation and exposure to sunlamps or sunbeds  
Soots  
Strong inorganic acid mists containing sulfuric acid  
Tamoxifen  
Tars and mineral oils  
Thiotepa  
Thorium dioxide  
Tobacco smoking  
Vinyl chloride

## APPENDIX 3-2

### THE RIGHT-TO-KNOW

In order to evaluate a potential chemical hazard, the worker not only needs exposure information, he/she also needs information about a chemical's composition, physical characteristics, and toxicity. Employers are required by law to provide this information. Two important OSHA standards give the right-to-know:

1. 29 CFR 1910.20 – Access to Exposure and Medical Records Standard
2. 29 CFR 1910.1200 – Hazard Communication Standard

Getting familiar with hazard communication can take some time, but it is important to have a good understanding of what is contained in the 29 CFR 1910.20 standard.

The Access to Exposure and Medical Records Standard gives workers and their union representative the right to see and copy important health and safety records kept by the employer. The standard doesn't require an employer to conduct medical tests or environmental monitoring. But if they do (to comply with other OSHA standards or for insurance purposes for example), they must give employees access to these records. In addition, they must keep the records for 30 or more years.

Employers must let workers see the records they request within 15 days of receiving a written request. They must also let workers photocopy them free of charge or lend them to the worker for a reasonable time.

Medical records are confidential. Workers do have the right to sign a form authorizing the release of the medical records to a physician of their choice. Medical records should include all the following:

- Medical histories and questionnaires
- Results of laboratory tests, including biological monitoring tests
- Results of medical exams
- Employee medical complaints
- Medical opinions, diagnoses, and recommendations
- Originals of x-rays and interpretations
- Description of treatment and prescriptions

Environmental exposure records are not confidential. Exposure records should include industrial hygiene sampling data from all types of sampling techniques and for all types of hazards.

For further information regarding this standard, please consult the instructor.

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**APPENDIX 3-3****OSHA MEDICAL SURVEILLANCE REQUIREMENTS**

The following list covers the most commonly asked questions concerning the OSHA medical surveillance requirements:

**1. Who is covered?**

- Individuals who may be exposed to hazardous substances at or above the PELs for 30 days or more per year.
- Individuals exposed above the PELs in an emergency situation.

**2. How frequent are the exams?**

- Prior to assignment, annually thereafter, and at termination of assignment.
- More frequent if a physician feels it is necessary.
- Whenever a worker develops signs or symptoms indicating a possible exposure to hazardous substances.

**3. What will the exams include?**

- Medical exam, questionnaire, and work history with special emphasis on symptoms related to hazardous substances.
- A determination of fitness to work wearing PPE during hot weather.
- Anything else the physician determines appropriate.

**4. Who pays for the examination?**

The employer pays for the exam. The exam must be conducted at a reasonable time and place without loss of pay to employees.

**5. Who gets the results of the exam?**

Exam results go to both the employer and the worker. Both the employer and worker are informed of the doctor's opinion of the worker's capability to work while wearing a respirator and PPE.

The employer is entitled to a written opinion limited to those medical conditions relating to work and/or occupational diagnosis. No specific findings or diagnoses unrelated to occupational exposure can be given to the employer by the physician.

## APPENDIX 3-4

### DOE DRUG TESTING

#### SUBSTANCE ABUSE PROGRAMS AT DOE SITES: 10 CFR PART 707

10 CFR Part 707 applies to contractors and subcontractors who have the management and/or operating contracts on sites owned or controlled by DOE. There is a \$25,000 threshold, meaning that the contract has to be a minimum of \$25,000 before the conditions apply. The provisions apply to:

- Employees who handle classified information or nuclear materials.
- Workers whose jobs may pose a risk to life, safety, environment, public health, or the national security.
- Employees involved in the transportation of hazardous materials to or from DOE sites.

Part 707.5 (d) states:

“Contractors are required to submit all subcontracts they believe to be within the scope of this part to DOE for determination as to whether the subcontract falls within the scope of this part. Subcontractors so determined to fall within the scope of this part shall be required to agree to comply with the requirements, as a condition of eligibility for performing the subcontract.”

#### Provisions of the DOE Rules

Under the DOE rule, there must be a written substance abuse program that must include the following elements:

- Prohibit the use, possession, distribution, and manufacture of illegal drugs at DOE sites.
- Require that employees notify their employer of a drug conviction if the offense occurred on a DOE site.
- Include training provisions and plans for the instruction of supervisors and employees regarding substance abuse and assistance.
- Provide for distribution of the policy requirements and provide notice that adherence to the requirements is a condition of employment.
- List the required action upon conviction of a criminal drug statute. They are:

- Discipline up to and including discharge.
- or**
- An opportunity to participate in a rehabilitation program.

**Who Must Be Tested?**

The regulations require the following:

- Contractors must drug test, at a minimum, those workers considered by the contractor to have a potential to affect the environment, public health, and/or safety, such as:
  - Armed security, pilots, fire fighters, construction and maintenance workers of nuclear reactors, and hazardous waste workers (if they handle sufficient amounts of hazardous waste to cause harm to the public or the environment.)
  - Workers with unescorted access to control areas of DOE reactors.
- The contractor must notify DOE of positions to be tested for.
- Unlike other federal drug testing regulations, such as DOT, it is permissible to include other positions under the same drug testing program as those in safety sensitive positions.

**Required Circumstances for Drug Testing**

The regulations require that workers be tested under the following circumstances:

- **Preemployment/preassignment testing** – Preemployment and/or preassignment testing occurs either during the hiring process or when applying for one of the designated positions that require testing.
- **Random testing** – Random testing requires that 50% of the number of covered positions be tested on a random basis each year. For example, if a contractor employs 100 workers in safety sensitive positions, he must conduct 50 tests in the course of a year. There is a 100% target rate for workers with access to high security (Personnel Security Assurance Program) and those workers with access to nuclear explosives (Personnel Assurance Program).

Random testing should not be confused with “periodic testing,” which is selecting a specific individual to be tested at a specific time without cause or without a

random selection process. During random testing all members in a “random testing pool” have an equal chance of being selected for a random drug or alcohol test at any time. Most random testing policies require the selected individual to report to the designated collection site within two hours of notification of selection. Even after an individual is selected and tested, that individual remains part of the testing pool of workers to be drawn from. Therefore, it is possible some workers in a random testing pool could be tested several times in the course of a year while others would not be selected.

- **Postoccurrence testing** – Regulations require that workers be tested after a DOE occurrence. An *occurrence* is any event or incident that is a deviation from planned or expected behavior or events, such as:
  - Injury or fatality
  - Involvement of nuclear explosives
  - Accidental release of pollutants
  - Accidental release of radioactive material above regulatory limit.

Postoccurrence testing also applies if an individual could have caused or contributed to an occurrence.

- **Reasonable suspicion testing** – Under these regulations, a worker in a designated position may be drug tested if his/her behavior creates the basis for reasonable suspicion of the use of illegal drugs. Two or more supervisory or management officials must decide whether it is appropriate to test a worker based on this reasonable suspicion. At least one of the two supervisors must be in the worker’s direct chain of supervision or a site occupational health physician.

According to 10 CFR Part 707, reasonable suspicion testing must be based on an “articulable belief” drawn from “particularized fact” and “reasonable inferences” from those facts that the employee is under the influence of drugs. This includes:

- Direct observation of use, possession, or physical symptoms of being under the influence.
- A pattern of abnormal conduct or erratic behavior.
- Arrest or conviction of a drug-related offense.
- Information provided by a reliable and credible source.
- Evidence of drug test tampering.

- Having given a specimen in the past where the temperature of the specimen was outside the normal range (90.5° F - 99.9° F).

A worker's prior history of drug use or having been in rehabilitation is not, by itself, grounds for testing.

- **Return to duty/postrehabilitation testing –**  
Under these regulations, workers who are returning to duty following a determination of illegal drug use and following completion of a program of rehabilitation will be subject to unannounced drug testing, at intervals, for a period of 12 months.

### Drugs Tested

DOE regulations specify the following drugs must be tested for:

- NIDA 5, which includes marijuana, cocaine, opiates, amphetamines, and PCP.
- Any Schedule I controlled substances, which include drugs that are not used even by prescription, such as heroin.
- Schedule II controlled substances which include those drugs with a very high potential for abuse, such as morphine and percodan.

### THE DOE TESTING PROCESS

The Department of Health and Human Services (*DHHS*) Guidelines and DHHS Laboratories must be used for drug testing procedures.

The urine drug testing process includes four steps:

1. Collection
2. Initial screening
3. Confirmation
4. Verification

### Collection

On DOE sites, the sample collection and testing facilities must follow specific federally designated procedures entitled "Mandatory Guidelines for Federal Workplace Testing Programs" (September 1, 1994). The sample collection and handling procedures are called the chain of custody for the sample. The collection process includes the following steps:

1. Testing must take place in a secured location with access limited to the worker being tested and testing-site personnel.

2. Personnel must use a standardized chain of custody form and limit the number of people who handle the specimen.
3. The worker provides a urine sample of at least 30 ml (about one ounce) in a cup. The sample is normally given in privacy. The collection site may use the following procedures to ensure the sample's integrity:
  - Photo ID or other personal identification
  - Wash hands prior to sample delivery
  - No water in the sample stall
  - Bluing agent in toilet water
  - Removal of excess clothing, etc., to minimize sample substitution or adulteration
  - Direct observation of the individual giving the sample

In addition to these measures, collection site personnel will note any unusual behavior on the part of the worker.

While not required under DOE regulations, a worker may request a split sample. The sample is divided into two parts. One part is used for testing. The other part is stored in case it is needed to verify the test results of the first sample.

4. A collection agent (employer or lab personnel) takes the sample immediately. The sample's temperature is checked to make sure it was recently voided and not diluted or adulterated.
5. The worker signs or initials a label for use in sealing the sample container.
6. A collection agent seals the sample in the presence of the worker. The worker signs a chain of custody form or log that states who received the sample and acknowledges the sample was sealed in the worker's presence. The chain of custody form goes with the sample until it gets to the lab. Each person who handles the sample signs the form in order to make the chain of custody valid.

The sealing process is extremely important to ensure the chain of custody (which serves to minimize disputes over adulteration and mislabeling) until the sample arrives at the testing laboratory.

7. The sample is sent to a laboratory for testing. DOE uses laboratories certified by the federal government. These laboratories are rigorously inspected and subject to continuous quality assurance checks. Upon arrival, lab personnel conduct initial tests on the sample to make sure it's valid and has not been tampered with (e.g., fluids or adulterants added).
8. Once the sample is validated, the testing begins.

### Initial Screen

An initial screen (immunoassay test) is used to detect the level of *metabolites* at specific cut-off levels for each drug. Metabolites are the by-products of drugs as they are broken down and passed through the body. If the sample is below the cut-off level, the lab reports back that the result was negative. All samples, including the split sample in storage if there was one, are disposed of.

If the result is at or higher than the cut-off level, a confirmation test of the same sample is conducted using a more accurate test known as gas chromatography/mass spectrometry (*GC/MS*). *GC/MS* is considered 100% accurate (except for human error). *GC/MS* tests also use cut-off levels to confirm the presence of drug metabolites. If the level of metabolites in the sample measures below the cut-off level, the lab reports the test as negative and all samples are destroyed.

### Confirmation

If the metabolite level is above the cut-off level, the result must be forwarded to a medical review officer (*MRO*) for further investigation. All federally regulated drug testing requires the use of an *MRO* before releasing a positive test result. In nonregulated environments the *MRO* as a final step is not required, but is highly recommended to reduce employer liability.

The role of the *MRO* is to determine if legitimate reasons exist for a positive test result. For example, the *MRO* may investigate any of the following:

- Legitimate use of a prescription drug under a doctor's orders.
- Ingestion of poppy seeds in the case of a positive opiate result.
- Member concerns about procedural or chain of custody errors.

**Verification**

All federal regulations provide that the MRO should attempt to review the results of a positive drug test with a worker before declaring a test as positive, if only by telephone. Usually the MRO has a designated time period (e.g., 48 hours) to contact a worker to investigate. If the MRO cannot contact the worker, the determination is based on the information at hand. This may result in a verified positive result, unless the MRO determines a problem with the collection or testing procedure, or if a suitable explanation (such as prescribed medication) has been provided by the worker on the chain of custody form. For this reason, it's important for workers to provide information about where they can be reached in the 48-72 hours following a drug test, so the MRO can contact them for any necessary information.

**Required Action Upon  
Confirmed Positive Test**

Once a drug test has a confirmed positive result, the following required actions must be taken:

- Applicants will not be considered for employment.
- Those workers in testing designation positions must be removed from those positions.
- First offenders may be offered rehabilitation. They will be placed in another job position. If no other job positions are available, they will be placed on leave status until their rehabilitation is completed.
- The worker may return to the testing designated position after:
  - Successful completion of counseling or rehabilitation program
  - Negative urine drug screen
  - Evaluation by occupational medical department
- Second offenders must be removed from DOE-related employment.
- A worker will have the opportunity to report legitimate use of a prescription medication to the MRO before notification of the employer.
- The contractor must inform the worker of his/her right to retest the same sample at another federally certified lab at the worker's expense.

**RECORD KEEPING**

A confirmed positive test is given to the MRO and also to the contractors/DOE officials with a “need to know.” The MRO is only allowed to report whether a test is positive and cannot release quantitative results to the contractor.

A contractor has several responsibilities regarding record keeping. The contractor must:

- Maintain maximum confidentiality of the records.
- Ensure that the lab maintains retrievable records for a minimum of 5 years and that positive samples are maintained and kept frozen for 6 months.
- Maintain chain of custody forms as part of a worker’s medical records. Forms must include the following information regarding each testing occurrence:
  - Date
  - Tested person’s name and social security number
  - Specimen number
  - Type of test (grounds)
  - Temperature range of specimen
  - Remarks related to unusual behavior or conditions
  - Tested person’s signature to show ownership
  - Collector’s signature

**EMPLOYEE  
ASSISTANCE  
EDUCATION AND  
TRAINING**

In addition to drug testing requirements, contractor programs are also obligated to provide assistance and training to workers and supervisors as a more proactive means of preventing workplace substance abuse.

**Employee Assistance Programs (EAPs)** – Worker help programs with emphasis on prevention, education, short-term counseling, referral, and follow-up to outside agencies. The contractor has no obligation to pay for treatment, but the programs must be available to all of the contractor’s on-site employees.

**Substance abuse education and training** – Must be provided to employees on a periodic basis and must cover the health and safety aspect of substance abuse. The program must provide for notification to the employees of the employer policy and rules. There must be a section covering employee assistance services and supervisory training on recognition and intervention of deteriorating job performance.





# HAZARDOUS WASTE WORKER

Section

**4**

Title

**PERSONAL PROTECTIVE  
EQUIPMENT**

## TRAINEE OBJECTIVES

After completing Section 4, you will be able to:

1. Define the following terms:

Degradation

Maximum use concentration

Permeation

Penetration

Protection factor

Qualitative fit test

Quantitative fit test

2. Write out the following abbreviations or acronyms.

APR

CPC

MUC

PAPR

PPE

SCBA

3. List the five types of respirators and their protection factors.
4. List the eight limitations of a half-face APR.
5. List the limitations of the full-face air line respirator.
6. List the limitations of SCBAs.
7. List the PPE used in Level A.
8. List the PPE used in Level B.
9. List the PPE used in Level C.
10. List the PPE used in Level D.

**Standard Operating Procedures**

1.     Inspect a half-face APR.  
       Don a half-face APR.  
       Perform a negative pressure check with a half-face APR.  
       Perform a positive pressure check with a half-face APR.  
       Clean, sanitize and maintain a half-face APR.
2.     Inspect a full-face APR.  
       Don a full-face APR.  
       Perform a negative pressure check with a full-face APR.  
       Perform a positive pressure check with a full-face APR.
3.     Complete an irritant smoke or banana oil qualitative fit test.
4.     Clean, sanitize, and maintain a full-face APR.
5.     Inspect a full-face atmosphere supplying respirator.  
       Don a full-face atmosphere supplying respirator.  
       Clean, maintain, and store a full-face atmosphere supplying respirator.
6.     Inspect, maintain, and store the PPE used in Level D.  
       Inspect, maintain, and store the PPE used in Level C.  
       Don the PPE used in Level C.  
       Inspect, maintain, and store the PPE used in Level B.  
       Don the PPE used in Level B (buddy needed).  
       Inspect, maintain, and store the PPE used in Level A.  
       Don the PPE used in Level A (buddy needed).
7.     Refill a 2200 psi SCBA cylinder with a cascade charging system.

**INTRODUCTION**

*Personal protective equipment (PPE)* is any protective clothing or device worn to prevent contact with, and exposure to, hazards in the work place. Hazards may be chemical or nonchemical although hazardous waste workers are most concerned with chemical PPE. Examples of PPE include respirators, gloves, protective suits, boots, hard hats, and safety glasses.

PPE is critical to the safe performance of hazardous waste work. Therefore, workers need an appreciation of the types of PPE, their limitations, and what goes into the selection process. The PPE issue is made more complicated because no one type protects against all chemical exposure situations. As a result, there are many types of protective gear. Choosing the correct type requires that the industrial hygienist have a detailed knowledge of the chemical exposure(s) at hand. This section discusses the following areas of PPE:

- Respirators
- Protective clothing
- Protective ensembles

**RESPIRATORY PROTECTION**

A respirator is a piece of equipment that reduces chemical exposures by preventing contaminants from being inhaled. There are many different types of respirators, all useful in specific situations. Respirators are composed of a facepiece that seals out contaminants, and a device that provides clean air. Two types of respirators are used for obtaining clean air:

1. Air purifying – Filters are used to purify the air
2. Atmosphere supplying – A supply of clean air is provided from a tank or hose

Respirators differ in how much protection they afford. A paper mask is less protective than a firefighter's respirator with an air tank. But how much difference is there? Industrial hygienists have developed a scoring system to rank different types of respirators. Each respirator is given a score based on the amount of protection it can provide. This score is known as a *protection factor (PF)*.

## Protection Factors

The key to understanding respirator protection is to realize that all respirators leak to a certain degree. The amount of leakage depends on how well the facepiece seals to the face. A leak in the facepiece means that contaminated air can enter the facepiece. The act of inhaling creates negative air pressure inside the facepiece that results in a slight suction effect. The suction can draw in contaminated air. These leaks compromise the protection given by the respirator. Breathing contaminated air can lead to adverse health effects depending on the type and amount of chemical.

Respirators are tested for leakage by measuring the contaminant levels both outside and inside the respirator. Using the ratio of these two measurements, a PF is assigned. A PF is based on the assumption that the respirator is working properly, is worn correctly, and fits the wearer. Respirator PFs range from 5 to 10,000.

**The lower the PF, the lower the protection. The higher the PF, the higher the protection.** Figure 4-1 shows the calculation for determining the PF.

*The PF is calculated by dividing:*

$$\begin{aligned} \text{PF} &= \frac{\text{Concentration of airborne contaminant outside respirator}}{\text{Concentration inside the respirator}} \\ &= \frac{500 \text{ ppm (concentration outside the respirator)}}{50 \text{ ppm (concentration inside the respirator)}} \\ &= 10 \end{aligned}$$

**Figure 4-1.** Calculating the protection factor.

The goal of a respirator is to reduce the amount of hazardous chemical inside the mask to below the Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL). Respirators must be chosen to ensure that workers are never overexposed while wearing the respirator. The practical application of

PF for the hazardous waste worker can be summed up as: How much of the outside contaminant level is reduced by the respirator? Examples follow:

- A respirator with a PF of 10 reduces a worker's exposure by 10 times, or to 1/10 of the outside level. Therefore, if the contaminant level outside the respirator is 500 ppm, the contamination inside the respirator is 50 ppm. Should the PEL for the contaminant be below 50 ppm, the worker is overexposed. A PF of 10 means that the respirator can only be used in exposures up to 10 times over the PEL.
- A respirator with a PF of 10,000 reduces the worker's exposure by 10,000 times. Concentration inside the respirator may be 1/10,000 of the outside level.

**Remember:** The lower the PF, the lower the protection. The higher the PF, the higher the protection.

### Maximum Use Concentration

*Maximum use concentration (MUC)* is that level of contaminants which, if exceeded, will cause a worker to be exposed above the PEL because of leakage into the respirator. The MUC is the highest concentration of contaminants in which a respirator can be used safely. At no time should a respirator be used in an environment that exceeds the MUC.

The MUC is calculated by multiplying PF times PEL. Figure 4-2 gives an example of calculating the MUC for nitric acid.

*Calculate the MUC of nitric acid:*

MUC = PF x PEL

PEL for nitric acid = 2 ppm

PF of half-face respirator = 10

MUC = 2 ppm x 10  
= 20 ppm

A half-face respirator cannot be used in atmospheres with a nitric acid concentration greater than 20 ppm.

**Figure 4-2.** Calculating the MUC for nitric acid.

**AIR PURIFYING  
RESPIRATORS**

Air purifying respirators (*APRs*) clean the air a worker breathes by removing or filtering a contaminant from the air before it enters the wearer's lungs. *APRs* have two components—the facepiece and the filter or cartridge. When a worker inhales, contaminated air is pulled into the respirator through a filter or cartridge attached to the facepiece. The filter or cartridge removes the contaminant from the air before it enters the inside of the respirator through the inhalation valve. When the wearer exhales, air from the lungs reverses the airflow through the facepiece and out a separate valve called the exhalation valve.

**Negative Pressure  
Respirators**

*APRs* are commonly called negative pressure respirators. They depend on lung power to pull the air through the filters. The suction created when a worker inhales draws air into the respirator. This suction creates a momentary negative pressure. During inhalation, the negative pressure brings contaminants into the facepiece through leaks and improper seals. During exhalation air is blown out and a positive pressure is created in the facepiece. It's important to remember that negative pressure respirators must only be used if the oxygen level in the work place is above 19.5% oxygen.

**Disposable Paper Masks  
and Quarter Masks**

Many workers are familiar with the disposable paper masks. They are the throwaway type, and do not seal to the face well enough to provide a good fit. Laboratory tests done with mannequins show PFs of 5 to 10. However, studies done under actual work conditions show even lower PFs. The leakage for this type of mask is too severe. Furthermore, the paper of a disposable mask is only effective for large-particle dusts. Gases, vapors, fumes, and fine dusts, such as asbestos, may pass right through the paper. These masks are not to be used for hazardous waste site operations.

The quarter mask is normally a rubber mask, which fits from the top of the nose to the top of the chin. It uses cloth or cartridge filters. The PF is rated at 5. This type of mask it is not to be used for hazardous waste site work.

## Half-Face APRs

The half-face APR is made of rubber or plastic. It fits from the top of the nose to under the chin. Figure 4-3 shows a typical half-face APR.



**Figure 4-3.** The half-face APR fits from the top of the nose to under the chin.

A half-face APR uses one or two filter cartridges attached to the facepiece to filter the air. The fit given by the respirator rates a fairly low PF of 10 by the National Institute of Occupational Health (*NIOSH*). These respirators can be used in some situations, but the industrial hygienist must have an extremely high confidence in his or her knowledge of the type of chemical exposures that will occur, and how high the levels can potentially get. This knowledge may be possible in some factory situations, but it is difficult at a waste site. Because of this, the half-face filter respirator is rarely used.

Other limitations of the half-face APR are:

- No eye protection - The respirator does not cover the eyes. Goggles or face shields must be used.
- Cartridge life problems - The filter has a limited ability to remove chemical contaminants. When the saturation point is reached, chemicals begin to pass through the filter. This condition is called *breakthrough*. Some chemicals have *poor warning*

*properties* so a worker will not notice any chemical smell when breakthrough occurs. This situation can lead to serious exposure problems. As a result, the half-face APR cannot be used for chemicals with poor warning properties. Some filters have end of service life indicators (*ESLI*), that change color when a filter is used up. However, few indicators have been successfully developed and most are for specific chemicals only.

- Cartridge efficiency problems - There are many types of organic solvents, but only one type of organic solvent filter. Studies show that while this filter is very efficient for some solvents, it allows other solvents to pass through quickly. For example, the organic vapor filter lasts 143 minutes in an atmosphere with a concentration of 1,000 ppm of 1-nitropropane. But at 1,000 ppm of ethyl chloride, the filter only lasts 5.6 minutes. Therefore, the half-face APR and filter are not used for solvents that have rapid breakthrough. However, not all solvents have been tested.
- Oxygen limitations - The half-face APR can only be used when sufficient oxygen is present in the work atmosphere. Normal breathing air contains about 21% oxygen. It can be less in confined areas with other chemicals present.
- Not suitable for areas of unknown chemicals or levels - The protection offered by this respirator is limited, therefore, it cannot be used for unknown situations. The levels might exceed 10 times the PEL or different chemicals might go right through the filter to cause health effects. Specific cartridges are manufactured to protect against specific chemicals and may not be used in some mixed chemical atmospheres.
- Not suitable for concentrations that are immediately dangerous to life or health (*IDLH*) - Under no circumstances should an APR be used in an IDLH atmosphere. For most chemicals this is not an issue, because the MUC is lower than the IDLH level. But

there are exceptions. For some chemicals, the IDLH is lower than the MUC and the respirator can not be used if the level approaches the IDLH level.

- Humidity problems - Some studies have shown that breakthrough occurs more quickly under conditions of high humidity.
- Usage - The useful life of a filter is limited once the filter is opened. Usually filters are discarded after each use, not to exceed one shift. If breakthrough occurs and is noticed, then filters are changed at that time even if it's less than one shift.

Half-face respirators are the minimum type used for hazardous waste work, but they are not common. The reason is half-face respirators have a low PF and many cartridge-related problems. One way to find out if there is a cartridge problem for a specific chemical is to refer to the NIOSH Pocket Guide. The Pocket Guide includes respirator recommendations. If there is a cartridge problem, NIOSH will not recommend that APRs be used.

Table 4-1 is a list of some chemicals that cannot be safely protected against by APRs. Table 4-2 lists general MUCs for chemical cartridges that have hazardous breakthrough problems.

**Table 4-1.** APRs cannot safely protect against these chemicals.

Acrolein	Methylene bisphenyl isocyanate
Aniline	Nickel carbonyl
Arsine	Nitro compounds
Bromide	Nitrobenzene
Carbon monoxide	Nitrogen oxides
Dimethylaniline	Nitroglycerin
Dimethyl sulfate	Nitromethane
Hydrogen cyanide	Ozone
Hydrogen fluoride	Phosgene
Hydrogen selenide	Phosphine
Hydrogen sulfide	Phosphorous trichloride
Methanol	Stibine
Methyl bromide	Sulfur chloride
Methyl chloride	Toluene diisocyanate

**Table 4-2.** The following table shows the MUCs for chemical cartridges that have hazardous breakthrough problems.

Type of Cartridge	Maximum Use Concentrations
Organic vapors	1,000 ppm
Acid gases	1,000 ppm
Sulfur dioxide	50 ppm
Chlorine	10 ppm
Hydrochloric acid	50 ppm
Ammonia	300 ppm
Methylamine	100 ppm

### Full-Face APR

A full-face APR is made of rubber or plastic. It covers the whole face, starting at the forehead, down over the temples and the eyes, and under the chin (Figure 4-4). The full-face APR has a NIOSH assigned PF of 50 because it is easier to get a good seal across the forehead than across the nose. Also, the respirator is held more securely in place because it has a harness instead of straps. The full-face APR uses the same types of filters as the half-face APR, so it also carries the same limitations. It does protect the eyes, although it has a tendency to fog up.



**Figure 4-4.** The full-face APR covers the whole face.

Some full-face APRs can use larger chin, chest, or back-mounted canister-type filters. These filters are larger, and have fewer limitations. There are several filters available in larger sizes for full-face APRs that are not available for half-face APRs. Since canisters are larger than cartridges, they have higher capacities. Even though full-face APRs protect more than half-face APRs, they still do not offer enough protection to be used in IDLH conditions.

### Powered Air Purifying Respirators

The powered air purifying respirator (*PAPR*) is an APR that uses a small, lightweight battery-operated blower to draw air through the filters and into the facepiece. It uses the same type of facepiece and filters as the full-face APR (Figure 4-5).



**Figure 4-5.** The powered air purifying respirator has a battery-operated blower.

The blower keeps a slight positive pressure inside the facepiece. This positive pressure reduces the likelihood of contaminants leaking into the respirator during inhalation. Any leaks from an imperfect seal tend to be outward.

Additionally, the blower offers the advantage of increased comfort for the user. Because the blower draws air into the facepiece, less work is required for inhalation. In addition, air is blown across the user's face and provides some degree of cooling.

Despite the fact that a PAPR seals the face in the same manner as the full-face negative pressure APR, the PFs assigned by government agencies vary. For example, OSHA assigns a PAPR a PF of 100 in the asbestos standard, while NIOSH assigns a PF of 50. The PF for a PAPR can vary even within the same agency. For example, OSHA assigns a PAPR a PF of 100 in the asbestos standard, but a PF of 50 in the lead standard.

### *PAPR Limitations*

The PAPR has two limitations:

1. Weak batteries cause the fan motor to slow down, thus delivering less air to the facepiece. The batteries are designed to last a full shift, and then require a full charge. PAPR units come with a small flow meter that enables you to test the air flow, and thus, the battery charge.
2. Under heavy work conditions, you can use more air than the PAPR provides, creating a negative pressure in the facepiece. This condition is called *overbreathing* a PAPR. When overbreathing occurs, the PAPR functions just like a negative pressure full-face respirator.

### *Hoods and Helmets*

Some PAPRs have loose-fitting *hoods* and *helmets* instead of facepieces. While these hoods are comfortable, they provide less protection. NIOSH assigns a PF of only 25 for loose-fitting PAPRs.

## **FILTERING DEVICES**

Air purifying respirators are manufactured with two basic types of filtering devices:

1. Particulate filters
2. Vapor and gas removing canisters and cartridges

### **Particulate Filters**

Particulate filter respirators use a filter made of a fibrous material to capture contaminant particles before the air reaches the wearer's lungs. The particles are pulled through the filter as the worker inhales, and become trapped by the fibers of the filter. Particulate filter respirators are used for protection against particles

of dusts, fumes, and/or mists. Typical examples on construction sites include welding fumes, oil mists, silica, and asphalt fumes.

#### 42 CFR 84 for Particulate Filters

Respirator certification regulations 30 CFR 11 were first promulgated in 1972 and were commonly referred to as Part 11. Since that date, new research, tests, and technologies have required that certification regulations be revised. And in July 1995, the Part 11 standard was retitled 42 CFR 84 or Part 84.

NIOSH plans to revise the certification requirements for all respirator classes, although the process is expected to take many years. The revisions will take place in modules. The first module completed was the certification requirements for nonpowered, air-purifying, particulate-filtering respirators. These respirators now fall under Part 84. Therefore, all new nonpowered, air-purifying, particulate-filter respirators must be based on Part 84 performance testing procedures to receive NIOSH approval. All other respirators (PAPRs, SCBAs, etc.) are still under the Part 11 standard.

#### *Filter Labels*

Part 84 filter labels have two changes from Part 11 filter labels, which will help to tell them apart. These changes are shown below:

1. Sequence of approval numbers:

**Part 84** – TC-84A-XXXX

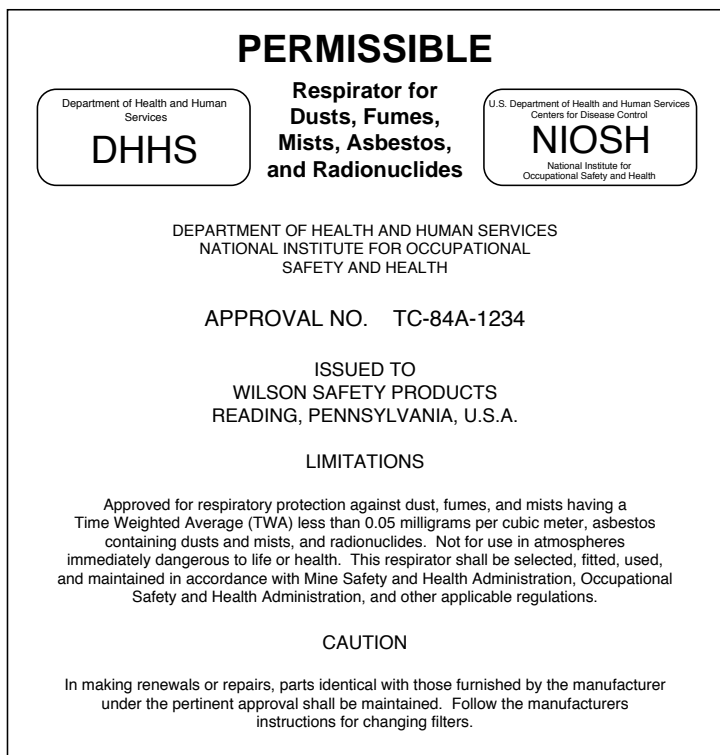
**Part 11** – TC-21C-XXX

2. Approving agencies:

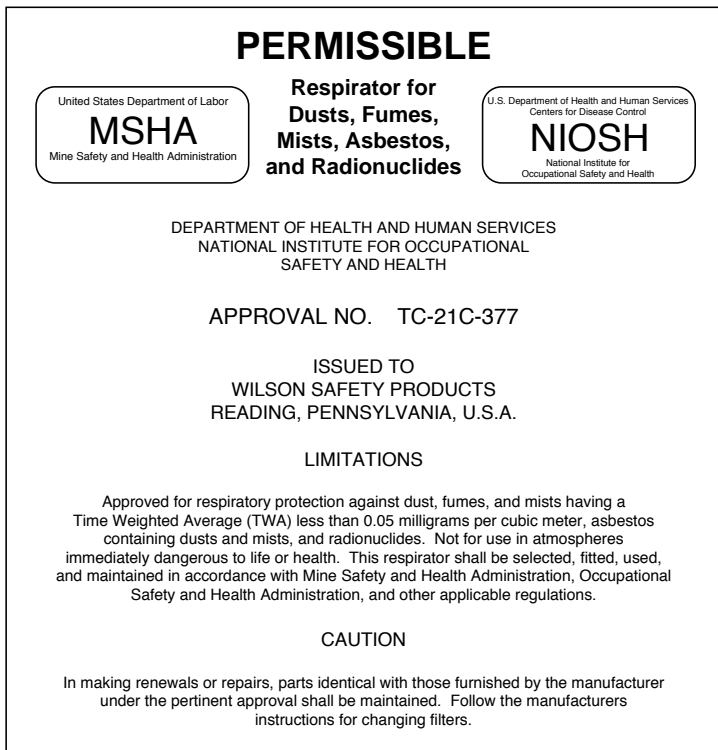
**Part 84** – NIOSH and the Department of Health and Human Services (*DHHS*)

**Part 11** – NIOSH and Mine Safety and Health Administration (*MSHA*)

Labels are normally found on the respirator box, cartridge box, or backpack. Figures 4-6 shows the Part 84 label for nonpowered, air-purifying particulate filters. Figure 4-7 shows the Part 11 label for all other respirators.



**Figure 4-6.** Part 84 label showing NIOSH and DHHS as the approving agencies.



**Figure 4-7.** Part 11 label showing NIOSH and MSHA as the approving agencies.

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Particulate Filter Efficiency	<p>Particulate filters are not designed to be 100% efficient in removing particulates from the air. It would be too hard for a worker to pull air through the filters when inhaling. Filters are manufactured to create maximum filter efficiency while keeping the resistance to breathing low. As contaminated air is drawn through the filter, the particles are captured by the filter, plugging up the holes between the fibers of the filter. This increase breathing resistance for the wearer.</p> <p>Particulate filter efficiencies are classified into two groups, high efficiency and lower efficiency. High efficiency filters are capable of capturing 99.97% of the particles pulled through the filter. Filters of this type are commonly called high efficiency particulate air (HEPA) filters. HEPA filters are used for dusts, fumes, and mists having an exposure limit less than 0.05 milligrams per cubic meter of air (0.05 mg/m<sup>3</sup>). Particulates with exposure limits this low are the most hazardous to workers' health, which explains why high efficiency filters are to be used. For example, HEPA filters must be used for exposures to asbestos or lead.</p> <p>Lower efficiency filters are less efficient than HEPA filters and capable of capturing approximately 99% of dust, fume, and mist particulates. Lower efficiency filters are used for particulates that have exposure limits greater than 0.05 mg/m<sup>3</sup>. These substances are not as hazardous to the health of exposed workers.</p>
Particulate Filter Classification	<p>NIOSH regulation Part 84 created nine classes of particulate filters, made up of:</p> <ul style="list-style-type: none"><li>• Three filter series for resistance to filter efficiency degradation</li><li>• Three filter efficiency levels</li></ul>
Filter Series	<p>The three filter series define different degrees of resistance to filter efficiency degradation. They are labeled as N, R, and P.</p>

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**N series filters** have the following characteristics:

- Used for solid or water-based particulates.
- **Not** resistant to oil. Cannot be used in atmospheres containing oil or for oil-based particulates.
- Can be used for more than one work shift if there are no problems with hygiene, damage, or breathing.

**R series filters** have the following characteristics:

- Used for solid or liquid particles.
- Resistant to oil but not oil proof.
- Can be used for an extended time in an oil-free atmosphere.
- Has limited use time in an environment containing oil (one 8-hour shift or a combined total of 8 hours.)

**P series filters** have the following characteristics:

- Used for solid or liquid particles, both oil-based and non-oil based.
- Considered oil proof. Can be used as long as a worker has no breathing problems.

An easy way to remember the filter series is:

- N is **N**ot resistant to oil
- R is **R**esistant to oil
- P is oil **P**roof

**NIOSH update to selection guide:** Originally, it was assumed P-series filters would not degrade from oil exposure and would only need to be changed when breathing resistance, hygiene concerns, or filter damaged occurred. However, a recent NIOSH study indicates the P-series particulate filter may lose efficiency with long-term exposure to oil. Therefore, NIOSH recommends replacing any P-filter that has been exposed to oil after the work shift. No changes were made to the selection logic for the N and R series filters.

*Filter Efficiency Levels*

Each of the three filter series has three filter efficiency levels. The minimum efficiency levels are 95%, 99%, and 99.97%. They have the following designations:

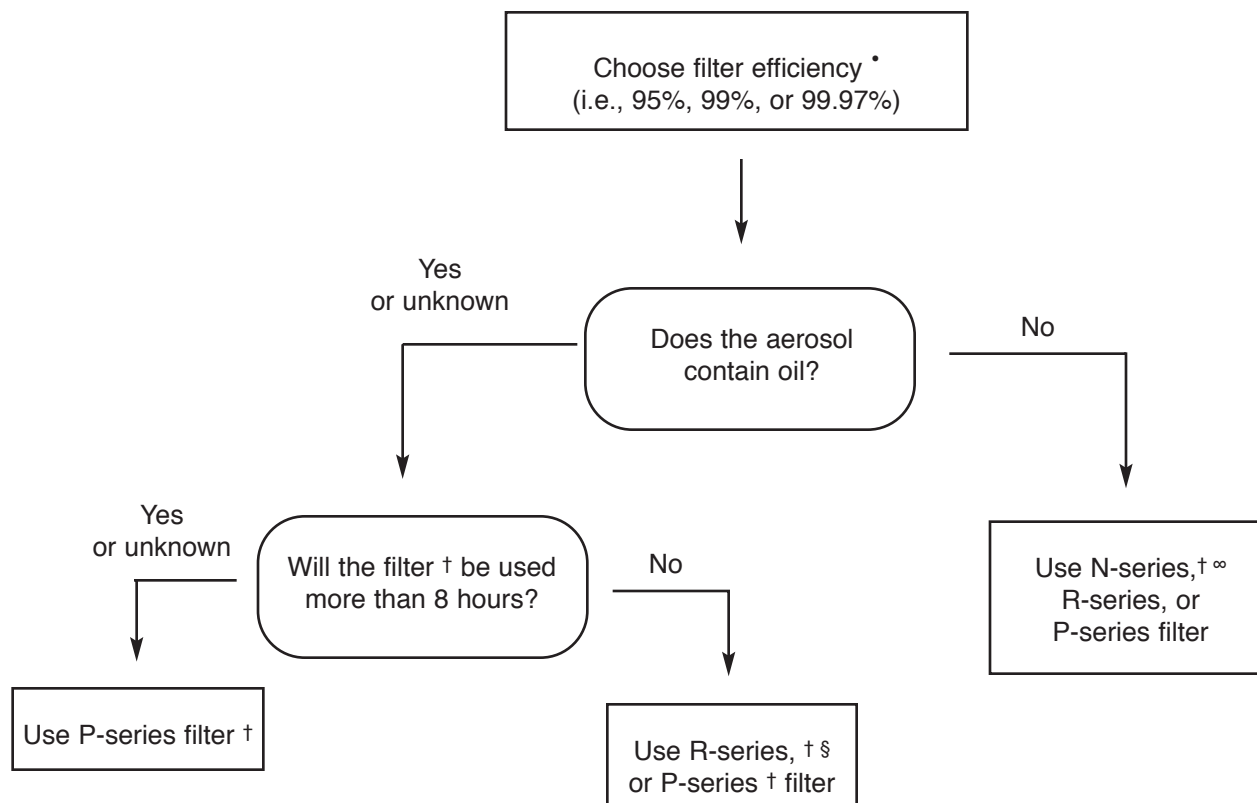
- Filters with N95, R95, and P95 designations are certified as having a minimum efficiency of 95%. The series of 95% efficiency filters replaces the dust/fume and dust/fume/mist filters.
- Filters with N99, R99, and P99 designations are certified as having a minimum efficiency of 99%.
- Filters with N100, R100, and P100 designations are certified as having a minimum efficiency of 99.97%. These filters replace the *high efficiency particulate air (HEPA) filters* under the old certification standard. Unlike the old HEPAs, the N100 and R100 have the following limitations:
  - N100 - no oil exposure
  - R100 - oil exposure for one shift only

The P100 filter is the only filter that will keep the familiar magenta color.

Table 4-3 lists the nine classes of particulate filters. Figure 4-8 shows the decision process for choosing the appropriate filter.

**Table 4-3.** The nine classes of particulate filters are listed below.

Filter Series	Filter Efficiency Levels	Filter Classes	Service Time
N-Series	99.97%	N100	Non-specific
	99%	N99	Non-specific
	95%	N95	Non-specific
R-Series	99.97%	R100	One Shift
	99%	R99	One Shift
	95%	R95	One Shift
P-Series	99.97%	P100	Non-specific
	99%	P99	Non-specific
	95%	P95	Non-specific



- The higher the filter efficiency, the lower the filter leakage.

† Limited by considerations of hygiene, damage, and breathing resistance.

∞ High (200 mg) filter loading in the certification test is intended to address the potential for filter efficiency degradation by solid or water-based (i.e., non-oil) aerosols in the workplace. Accordingly, there is no recommended service time in most workplace settings. However, in dirty workplaces (high aerosol concentrations), service time should only be extended beyond 8 hours of use (continuous or intermittent) by performing an evaluation in specific workplace settings that demonstrates (a) that extended use will not degrade the filter efficiency below the certified efficiency level, or (b) that the total mass loading of the filter is less than 200 mg (100 mg per filter for dual-filter respirators).

§ No specific service time limit when oil aerosols are not present. In the presence of oil aerosols, service time may be extended beyond 8 hours of use (continuous or intermittent) by demonstrating (a) that extended use will not degrade the filter efficiency below the certified efficiency level, or (b) that the total mass loading of the filter is less than 200 mg (100 mg per filter for dual-filter respirators).

**Figure 4-8.** Flow chart for selecting Part 84 particulate filters.

**Vapor and Gas  
Removing Cartridges  
and Canisters**

Vapor and gas removing cartridges and canisters are used with APRs to protect workers from exposures to air that is contaminated with toxic vapors and gases.

While particulate filters are effective for nearly all types of particles, gas and vapor removing cartridges and canisters are designed to protect against specific individual contaminants. Examples include carbon monoxide, ammonia gas, or combinations of gases and vapors, such as acid gases or organic vapors.

Contaminants are removed as inhaled air enters the cartridge or canister and passes through a granular material called a *sorbent*. The sorbent absorbs contaminants from the air, and provides protection to the wearer from the toxic effects of the gas or vapor.

Materials used as sorbents include activated charcoal, silica gel, and various mixtures of specific chemicals that will capture the contaminant. Initially a gas and vapor sorbent is 100% efficient in capturing a contaminant. As the sorbent is used up, the efficiency decreases. When the sorbent is exhausted, the contaminant passes completely through the sorbent and into the facepiece where it is inhaled by the wearer. This loss of capturing efficiency is opposite to particulate filters which become more efficient as particles collect on the filter.

Sorbents for gases and vapors are packaged into either cartridges or canisters. The only difference between a cartridge and a canister is the amount of sorbent they contain. Cartridges are designed to be used singly or in pairs on quarter-, half-, and full-facepieces. The amount of sorbent contained in a cartridge is small, making their useful lifetime short in duration. This limitation restricts the use of cartridges to low concentrations of gases and vapors.

Canisters contain larger amounts of sorbent material than cartridges. Therefore, they can be used in situations where the workplace air concentration of gases or vapors is high. Canisters are designed as chin, front, or back-mounted devices. When a canister is used with a facepiece, the respirator is called a gas mask.

Cartridges or canisters are designed for either one specific type of gas or vapor, or a combination of gases and vapors together. In addition, some cartridges and canisters are manufactured to protect against both gases and vapors, as well as particulates by combining particulate filters with sorbent materials. When filters are combined with gas and vapor sorbents, the filter is located in the inlet side of the cartridge. It is either built into the cartridge itself or held to the outside of the cartridge by a snap-on cover.

Both canisters (gas masks) and chemical cartridges are available for the following specific gases and vapors:

- Ammonia
- Organic vapors
- Pesticides
- Vinyl chloride
- Hydrogen fluoride
- Hydrogen sulfide
- Formaldehyde
- Acid gases (chlorine, hydrogen chloride, sulfur dioxide)

Only chemical cartridges are available for these additional substances:

- Paints, lacquers, and enamels
- Mercury
- Chlorine dioxide

Likewise, only canisters (gas masks) are available for:

- Chlorine
- Sulfur dioxide
- Carbon monoxide
- Ethylene oxide
- Hydrogen cyanide
- Hydrogen chloride

A color coding scheme has been established to identify the contaminants that a gas and vapor canister or cartridge protects against. The color coding is assigned to either individual contaminants or combinations of contaminants as shown in Table 4-4.

**Table 4-4.** Contaminant color coding is shown below.

<b>Atmospheric Contaminant Color</b>	<b>Assigned</b>
Acid Gases	White
Organic Vapors	Black
Ammonia Gas	Green
Carbon Monoxide Gas	Blue
Acid Gases and Organic Vapors	Yellow
Acid Gases, Ammonia, and Organic Vapors	Brown
Acid Gases, Ammonia, Carbon Monoxide, and Organic Vapor	Red
Other Vapors and Gases not listed above	Olive
Radioactive Materials (except Tritium and Noble Gases) (magenta)	Purple
Dusts, Fumes, and Mists (other than radioactive materials)	Orange

When the sorbent becomes exhausted or used up, breakthrough will occur. Warning signs include odor, taste, or throat irritation. If the wearer notices any warning signs, follow these steps:

1. Leave the work area immediately
2. Go to a location with fresh air
3. Notify the safety and health officer
4. Replace the cartridge or canister

Gas and vapor cartridges have short useful service times. Therefore, it is recommended workers discard their cartridges or canisters at least daily, even if no odor, taste, or irritation is detected. Some canisters are designed for use against substances with poor warning properties (no odor or taste). These canisters have end of service life indicators (*ESLIs*) that show the canister is exhausted and needs to be replaced. For example, cartridges used for mercury have *ESLIs* because mercury has poor warning properties that are not readily noticed by a worker being exposed.

## ATMOSPHERE SUPPLYING RESPIRATORS

There are two types of atmosphere supplying respirators—air line respirators and self-contained breathing apparatus (SCBA).

Both types of respirators supply clean breathable air to the wearer and do not depend on filters. With an air line respirator, air is delivered by a hose connected to a compressor. The compressor is equipped with a filtering system that purifies the air. The air for an SCBA is contained either in a compressed air tank or cylinder. The air in the tank or cylinder is under pressure. Regulators are used to reduce the pressure and control the flow of air into the facepiece.

There are two types of regulators:

- Demand flow
- Pressure demand

### Demand Flow vs. Pressure Demand Regulators

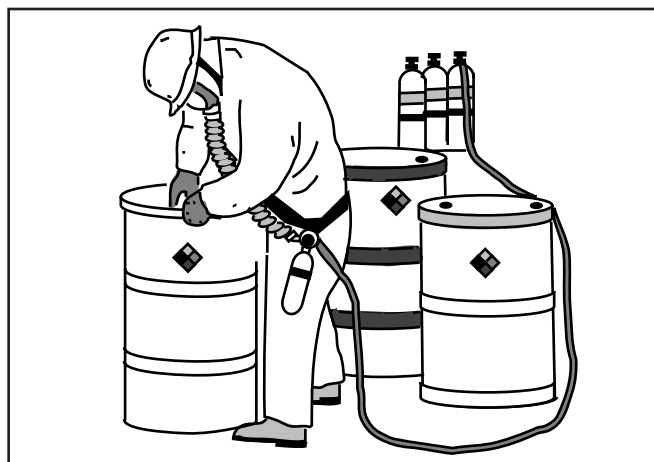
A demand flow regulator uses the suction force of inhalation to open the regulator valve and let air flow into the facepiece. In other words, when the worker “demands” the air, he or she gets it. When the wearer exhales, the flow of air into the facepiece stops. The advantage of the demand flow regulator is that the air supply is not wasted, so the time allowed by the tank is maximized. The disadvantage is that the regulator depends on negative air conditions during inhalation. Because of this, the PF for demand type atmosphere supplying respirators is only 50. A respirator with a demand flow regulator is **not** recommended for hazardous waste work.

Pressure demand regulators are similar to demand flow regulators in that airflow into the facepiece occurs mainly during inhalation. However, there is also a constant flow of air into the facepiece that keeps it pressurized. So, negative pressure conditions never exist, even during inhalation. Instead, positive pressure conditions exist at all times, and leakage is minimized. This regulator is used most often in hazardous waste operations.

**Air Line Respirators**

Air line respirators supply air to a facepiece through a length of hose. The hose is connected to either a compressed air cylinder or a compressor that is equipped with equipment to purify the air. The air supply can be used to pressurize the respirator to achieve a high PF. With a pressure demand regulator and a full facepiece, NIOSH assigns an air line respirator a PF of 2,000. The air line respirator, shown in Figure 4-9, is being used more and more for personnel and equipment decontamination. It has the following limitations when used in hazardous waste work:

- The air line impairs worker movement and cannot exceed 300 feet in length according to regulations. Workers must carefully retrace their steps coming off of the job.
- The air line can be damaged. Rough or sharp surfaces can puncture the line. Chemicals on the ground can deteriorate the rubber hose. Falling drums, vehicles, and heavy equipment can damage the air line.
- The location of the system air compressor. The compressor must be located away from potential chemical or contamination hazards. All filters and alarms must be working properly, and the system must be maintained according to the manufacturer's recommendations.



**Figure 4-9.** Air line respirators receive air from compressed air cylinders or air compressors.

Due to the limitations of air line respirators, they are often used with a small bottle of air for escape purposes. The bottle contains a 5 to 10 minute air supply. When this escape bottle is provided, NIOSH assigns the unit a PF of 10,000. Escape bottles are required for air line respirators being used in IDLH atmospheres.

### Self-Contained Breathing Apparatus

A self-contained breathing apparatus (SCBA) consists of a facepiece and regulator mechanism connected to a cylinder of compressed air that is worn by a worker (Figure 4-10). SCBAs are commonly used during the most hazardous aspects of waste site jobs because they have a NIOSH assigned PF of 10,000. With an SCBA, a worker does not have air line problems. Worker training is essential to the safe use of SCBAs.



**Figure 4-10.** SCBAs consist of a facepiece, regulator, and an air cylinder worn on the back.

There are different types of SCBAs with their own set of limitations. They include:

- Closed circuit or rebreathers
- Open circuit SCBAs
  - Entry
  - Escape

### Open Circuit vs. Closed Circuit SCBAs

With an open circuit SCBA, exhaled air goes through valves directly into the outside air. The system comprises a tank of breathing quality air containing

between 19.5% and 23.5% oxygen, a regulator, and the respirator. Open circuit tanks usually are rated at 30 to 60 minutes.

Closed circuit SCBAs are called rebreathers because the exhaled air goes back into the system to be recycled. A closed-circuit system consists of a scrubber device to remove exhaled carbon dioxide, a tank of pure oxygen, and a breathing bag to blend the mixture. The closed circuit unit supplies enough breathing air for up to four hours.

Rebreathers work in the following manner. The air for breathing is mixed in a flexible breathing bag. As the wearer inhales and deflates the bag, oxygen flows into the bag from the oxygen tank. The oxygen tank can contain either compressed or liquid oxygen. The exhaled air goes through a filter known as an alkaline scrubber, which removes the carbon dioxide from the exhaled breath. The scrubbed air then mixes with the oxygen in the bag, so that a breathing quality mixture is available for the next inhalation.

One problem for rebreathers is that they typically use demand regulators, which means that they have a lower PF. This demand type rebreather is not recommended for hazardous waste work. There are a few companies that make rebreathers with pressure demand regulators which can be used on a hazardous waste site. NIOSH has given them a PF of 10,000.

#### Escape vs. Entry SCBAs

The typical pressure demand SCBA is an open circuit unit with a large cylinder. It provides enough air for 30 to 60 minutes and weighs about 25 or 30 pounds. This SCBA is called an entry SCBA and is good for any type of work. Escape SCBAs are small cylinders capable of providing 5 to 15 minutes worth of breathable air. They do not provide enough air for entry to do work, but are only used for emergency evacuation. Some air line respirators have attached escape SCBAs which provide additional protection (PF is 10,000). Other escape SCBAs use hoods and workers wearing non-SCBA respirators use them for emergencies.

Pressure-demand, open-circuit, entry SCBAs are the work-horse respirators used on waste sites when hazards are severe or unknown. They provide excellent protection to the worker. The chief drawbacks to these respirators are their weight and a limited air supply. These limitations greatly affect the work schedule because the work day is broken up into many smaller segments. Also, some workers feel uncomfortable and confined in the respirator. It's important that workers be able to familiarize themselves with SCBA equipment, as well as practice using it before going in a hazardous area.

## **RESPIRATOR PROGRAM REQUIREMENTS**

The safe use of a respirator is more than just knowing how to put it on. OSHA Standard 1910.134 governs general requirements for respirator usage (Appendix C). The respiratory protection program must cover certain required work site-specific procedures for respirator use. Also it must be updated when there are changes in workplace conditions that affect respirator use. The respiratory protection program includes the following requirements:

1. Procedures for selecting respirators for use in the workplace.
2. Medical evaluations of employees who are required to use respirators.
3. Fit testing procedures for tight-fitting respirators.
4. Procedures for proper use of respirators in routine situations and reasonably foreseeable emergencies.
5. Procedures and schedules for cleaning, storing, inspecting, repairing, discarding, and otherwise maintaining respirators.
6. Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere supplying respirators.
7. Employee training in the respiratory hazards to which they are potentially exposed during routine and emergency situations.

8. Employee training in the proper use of respirators, including:
  - *Donning and doffing*
  - Limitations
  - Maintenance
9. Procedures for regularly evaluating the effectiveness of the program.

### **Respirator Program Administration**

The employer must designate a respirator program administrator (RPA) to oversee the respiratory protection program and to conduct the required evaluations of program effectiveness. To fulfill these duties, the RPA must have the training or experience that matches the complexity of the program.

As part of the administration of the program, the RPA is responsible for ensuring the following:

- Appropriate care is taken to properly select, use, and maintain the respirators.
- The nature of the air contaminant and its exposure concentration is considered in properly selecting a respirator.
- Workers are trained in the proper use and care of the respirators that are provided.
- Workers are medically fit to wear the respirator.

### **RESPIRATOR SELECTION**

Employers are responsible for selecting the appropriate respirators for their employees. To do this the employer must:

1. Gather information
2. Apply information to respirator selection process
3. Choose the respirator based on the selection process

**Gather Information**

It is impossible to choose a respirator without knowing the hazards on the work site and the workers' potential exposure levels. The employer can use two methods for identifying the hazards and their airborne levels:

1. Personal air monitoring devices.
2. Past exposure levels encountered on similar jobs.

It is very important that some actual or educated estimate of exposure levels is known before selecting a respirator. In the absence of such information, OSHA requires that the job's exposure level be considered *immediately dangerous to life and health (IDLH)*.

In addition to airborne hazards and their exposure levels, the employer must gather other types of information:

- General use conditions and determination of contaminants
- Properties of the contaminants
- Odor threshold data
- Exposure limits
- IDLH concentrations
- Eye irritation potential
- *Service life* information

Once the criteria information is gathered and evaluated, the employer applies it to a respirator selection process. The selection process uses a sequence of questions to identify the recommended class of respirators for the airborne contaminants. One example of this process is the Respirator Decision Logic from the National Institute of Occupational Safety and Health (*NIOSH*) located in the Appendix A of this manual.

**General Use  
Conditions and  
Determination of  
Contaminants**

General use conditions include the following:

- Descriptions of the job tasks to be performed
- Duration and frequency of the tasks to be performed
- Work location
- Physical demands of the work to be performed
- Respirator comfort

Determination of contaminants includes the following:

- Identity of the substances present in the air.
- Actual measured exposure level of the contaminant on the job.
- If possible, an estimate of the highest level of exposure that workers are likely to encounter.

### **Properties of the Contaminants**

Information is needed on the physical, chemical, and toxic properties of the contaminant. This information includes:

- Form in which the substance is found on the job site, such as dust, mist, fume, gas or vapor.
- Chemical properties, such as organic vapor, pesticide, metal, acid gas.
- Toxicological properties of the substance as they pertain to adverse health effects (e.g., *carcinogen*) and warning properties.

### **Odor Threshold Data**

Information on odor threshold is essential to determine whether a contaminant has warning properties at or below the exposure limit that would allow an APR to be selected. If the odor threshold exceeds the exposure limits, the contaminant is considered to have *poor warning properties*. Therefore, an APR would not be recommended for use unless it had an *end-of-service-life indicator (ESLI)*. Odor threshold data would be obtained from industrial hygienists or other experts such as NIOSH or OSHA.

### **Exposure Limits**

Several organizations require, recommend, or publish exposure limits. They are listed below:

- OSHA - Permissible exposure limit (PEL)
- NIOSH - Recommended exposure limit (REL)
- ACGIH - Threshold limit value (TLV)

Exposure limit information is necessary to calculate MUCs for the types or classes of respirators using their assigned PFs. The *NIOSH Pocket Guide to Chemical Hazards* is an excellent source of information for many chemicals and their exposure limits.

**IDLH Concentrations**

Contaminant concentrations that are IDLH are life threatening and call for the most protective respirators for the wearer. The *NIOSH Pocket Guide to Chemical Hazards* provides IDLH concentrations for many chemicals found in the workplace. The IDLH concentration for a substance must be compared to the actual concentration measurement of the substance on the job.

**Eye Irritation**

Some contaminants have the potential to cause eye irritation. In these situations, a full facepiece, hood, or helmet should be selected instead of a half mask to provide eye protection.

**Service Life Information**

Service life refers to the length of time a filter cartridge or canister will provide protection to the wearer. This information is necessary to determine a filter change schedule for the chosen respirator.

**MEDICAL EVALUATION**

Wearing a respirator may place a physiological burden on the wearer. Therefore, OSHA requires that an employer provide a medical evaluation to determine if a worker can wear a respirator. The evaluation must be done before a worker is fit tested or required to use a respirator.

**RESPIRATOR  
DECISION LOGIC  
SEQUENCE**

After criteria information is gathered and evaluated, the industrial hygienist follows a sequence of questions to identify the NIOSH recommended class of respirators for the airborne contaminants. The questions listed below are summarized from the Respirator Decision Logic document. They should be followed in sequence, while using the criteria information that has been gathered to select the proper respirator.

1. *Is the respirator to be used for firefighting?*
  - a. If yes, use a full facepiece SCBA operated in a pressure demand mode.
  - b. If no, go to step 2.
2. *Will the respirator be used in an oxygen deficient atmosphere?*
  - a. If yes, any type SCBA or atmosphere supplying respirator with auxiliary SCBA can be used.
  - b. If no, go to step 3.
3. *Will the respirator be used in emergency situations?*
  - a. If yes, use a full facepiece SCBA operated in a pressure demand mode or a full facepiece atmosphere supplying respirator operated in pressure demand mode in combination with an auxiliary SCBA operated in pressure demand mode.
  - b. If no, go to step 4.
4. *Is the contaminant a carcinogen?*
  - a. If yes, use a full facepiece SCBA operated in pressure demand mode, or a full facepiece atmosphere supplying respirator operated in pressure demand mode in combination with an auxiliary SCBA operated in pressure demand mode.
  - b. If no, go to step 5.
5. *Is the contaminant exposure level less than the OSHA PEL or NIOSH REL?*
  - a. If yes, a respirator is not required except for escape. Go to step 7.
  - b. If no, go to step 6.

6. *Is contaminant exposure level less than IDLH concentration?*

- a. If yes, go to step 7.
- b. If no, conditions are IDLH. Use a full facepiece SCBA operated in pressure demand mode or a full facepiece atmosphere supplying respirator operated in pressure demand mode in combination with an auxiliary SCBA operated in pressure demand mode.

7. *Is the contaminant an eye irritant?*

- a. If yes, respirators with full facepieces, helmet, or hood are recommended. Go to step 8.
- b. If no, half mask respirators may be used, depending on exposure concentration. Go to step 8.

8. *Determine the minimum PF that is required.*

Divide the measured exposure concentration of the contaminant by its OSHA or NIOSH exposure limit. For escape respirators, determine the potential for a hazardous condition to occur caused by an accident or equipment failure. Go to step 9.

9. *If the contaminant is a particulate, go to step 10.*

*If the contaminant is a gas or vapor, go to step 11.*

*If the contaminant is a combination, go to step 12.*

10. *Particulate Respirators*

- 10.1 Is the particulate respirator to be used only for escape purposes?
  - a. If yes, use the table of NIOSH recommendations for escape respirators.
  - b. If no, the respirator will be used for normal work activities. Go to step 10.2.
- 10.2 Determine the type of filter that should be used for the particulate contaminant. Go to step 10.3
- 10.3 Select a particulate respirator with a PF equal to or greater than the minimum PF calculated in step 8.

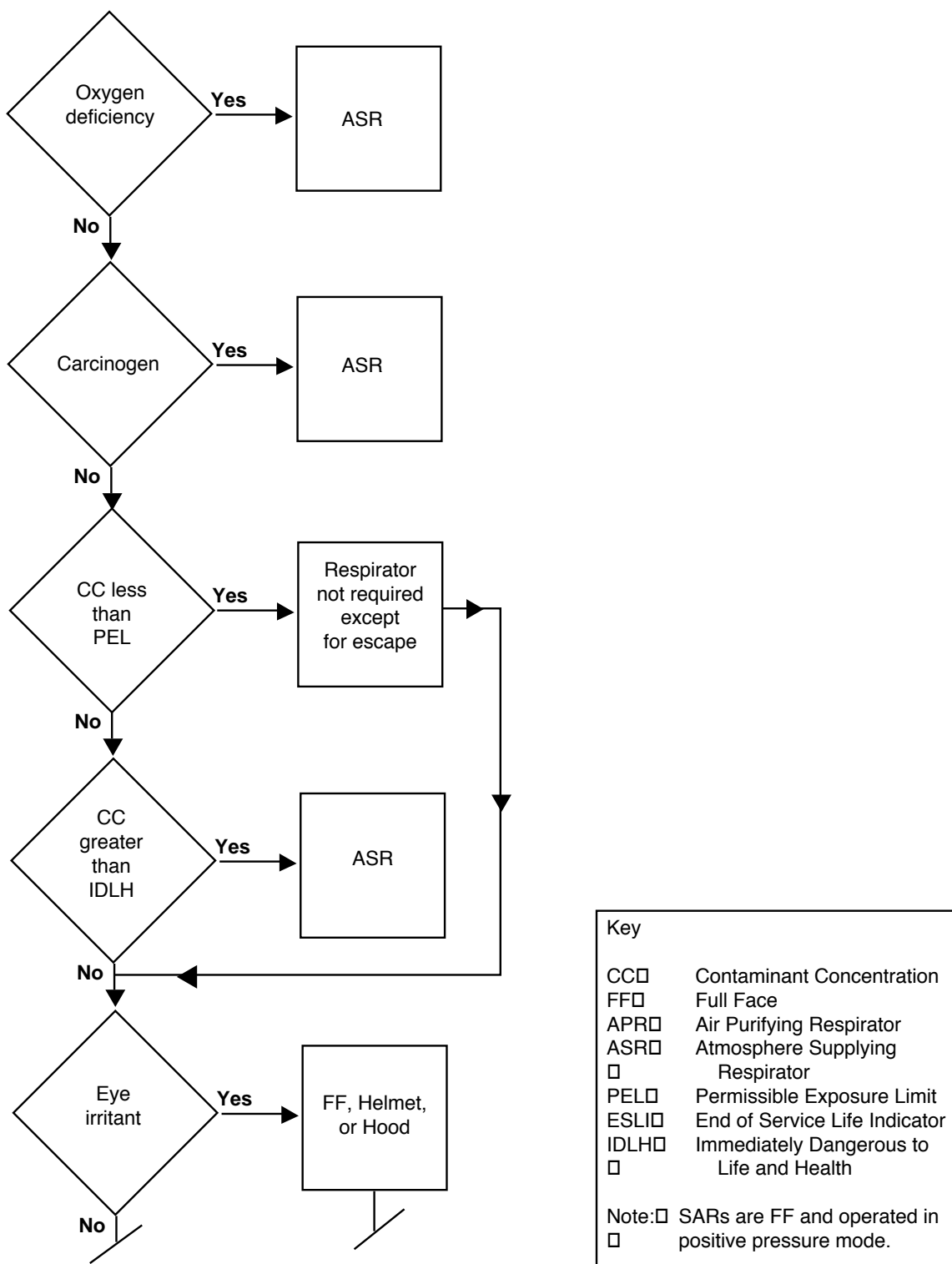
*11. Gas/Vapor Respirators*

- 11.1 Is the gas/vapor respirator to be used only for escape purposes?
  - a. If yes, use the table of NIOSH recommendations for escape respirators.
  - b. If no, the respirator will be used for normal work activities. Go to step 11.2.
- 11.2 Are the warning properties for the gas/vapor contaminant adequate at or below the exposure limit (PEL or REL)?
  - a. If yes, go to step 11.3.
  - b. If no, an APR equipped with an ESLI, a atmosphere supplying respirator, or a SCBA is recommended. Go to step 11.4.
- 11.3 An APR chemical cartridge/canister respirator is recommended. Go to step 11.4.
- 11.4 Select a gas/vapor respirator with a PF equal to or greater than the minimum PF calculated in step 8.

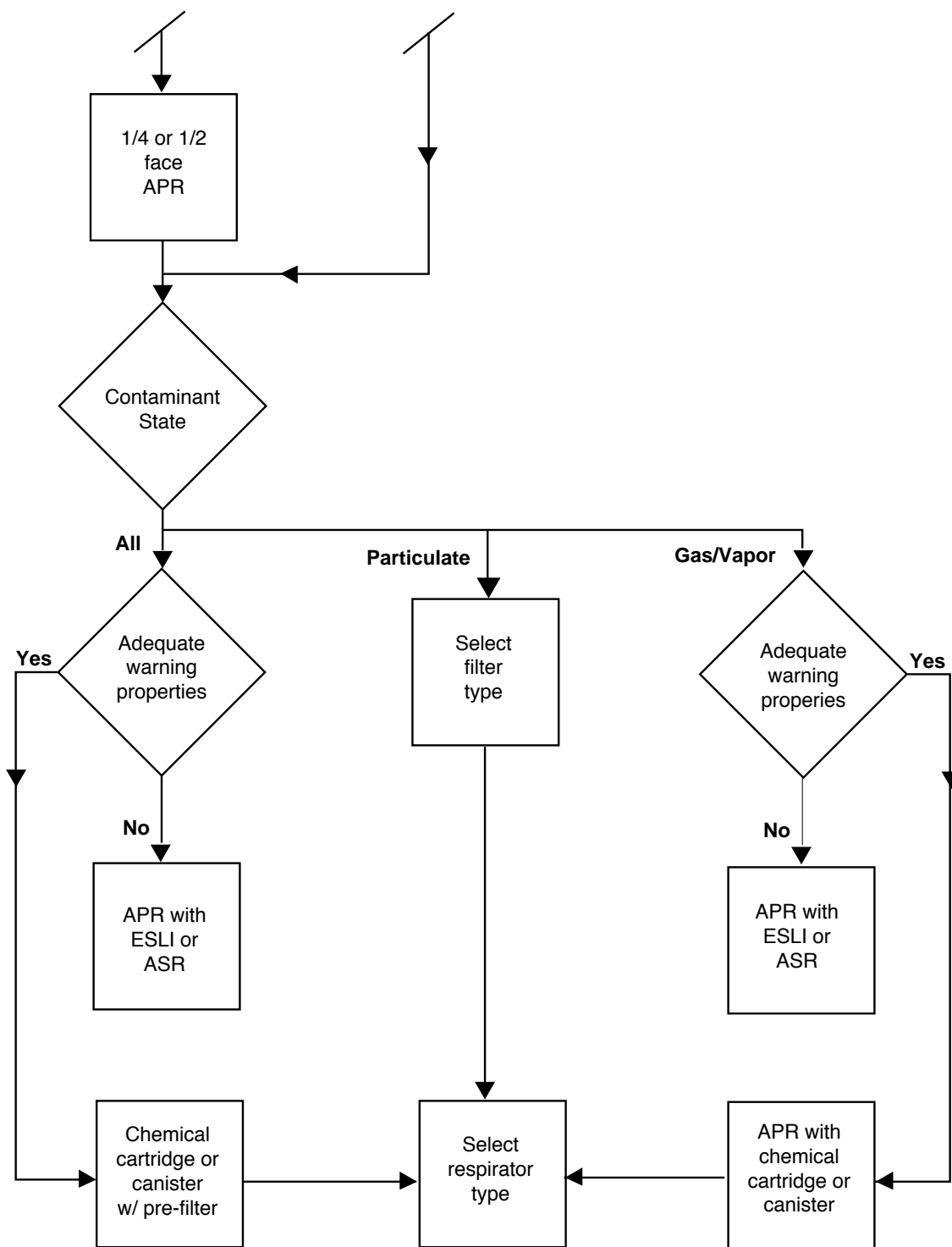
*12. Combination Particulate and Gas/Vapor Respirators*

- 12.1 Is the combination respirator to be used only for escape purposes?
  - a. If yes, use the table of NIOSH recommendations for escape respirators.
  - b. If no, the respirator will be used for normal work activities. Go to step 12.2.
- 12.2 Does the gas/vapor contaminant have adequate warning properties at or below the exposure limit (PEL or REL)?
  - a. If yes, go to step 12.3
  - b. If no, an APR equipped with an ESLI, an atmosphere supplying respirator, or a SCBA is recommended. Go to step 12.4.
- 12.3 Use an APR with chemical cartridge/canister that has a particulate pre-filter. Go to step 12.4.
- 12.4 Select a combination gas/vapor and particulate respirator with a PF equal to or greater than the minimum PF calculated in step 8.

Figure 4-11 shows the respirator decision flow chart. The chart helps the selector organize the information and keep track of the flow of questions in the sequence.



**Figure 4-11.** The respirator decision flow chart helps to organize the information gathered from the Respirator Decision Logic Process.



**Figure 4-11** (continued). The respirator decision flow chart helps to organize the information gathered from the Respirator Decision Logic Process.

**FIT TESTING**

A *qualitative fit test (QLFT)* or *quantitative fit test (QNFT)* must be performed on all negative or positive pressure tight-fitting respirator before a worker is required to wear it. The worker must be fit tested on the same make, model, size, and style of respirator that will be used in the workplace.

A *fit test* must be conducted at least annually and whenever changes in the worker's physical condition could affect the respirator fit. Such conditions include, but are not limited to:

- Cosmetic surgery
- Dental changes
- Facial scarring
- Obvious changes in body weight

Fit testing atmosphere supplying respirators and powered air purifying respirators (*PAPR*) shall be accomplished by performing the fit tests in negative pressure mode.

**Fit Testing Protocols**

OSHA has provided specific procedures for performing QLFTs and QNFTs. By following these procedures for each fit test, the test results will be consistent from one test to another. For a QLFT, the worker is tested using a testing agent to ensure that the respirator is fitting properly. For a QNFT, a machine is used to make sure that the respirator fits correctly.

**Qualitative Fit Test**

A QLFT is a pass/fail fit test used to check respirator fit that relies on the user's response to a test agent. It involves introducing a harmless odorous or irritating test agent into the breathing zone of the user. If the user does not detect the test agent, the respirator fits properly.

Four test agents are approved by OSHA for conducting a QLFT:

1. Banana oil (isoamyl acetate or isopentyl acetate)
2. Irritant smoke (stannic oxychloride or titanium tetrachloride)
3. Saccharin (sodium saccharin) solution
4. Bitrex™ (denatonium benzoate) solution

Before a test agent is used, OSHA requires an odor and taste threshold screening be conducted. The screening determines if the user can smell or taste the test agent at low concentrations. If the user can smell or taste the testing agent, he or she can be fit tested with it.

Qualitative fit testing addresses the following issues:

- Choosing the respirator needed.
- Determining comfort level. Comfort is important when respirators are used for long periods of time.
- Establishing a facepiece-to-face seal with a particular respirator.
- Identifying facial complications that affect the fit, such as dentures, facial surgery, or dental/oral surgery.

A QLFT is simple and inexpensive, which makes it the most common type of fit testing done for respirators. However, a QLFT relies upon a user's subjective response to the testing agent. In other words, the user must inform the tester if he/she can smell or taste the substance. Because of the subjectivity of the QLFT, a respirator should never be assigned a PF higher than 10 when using this type of test.

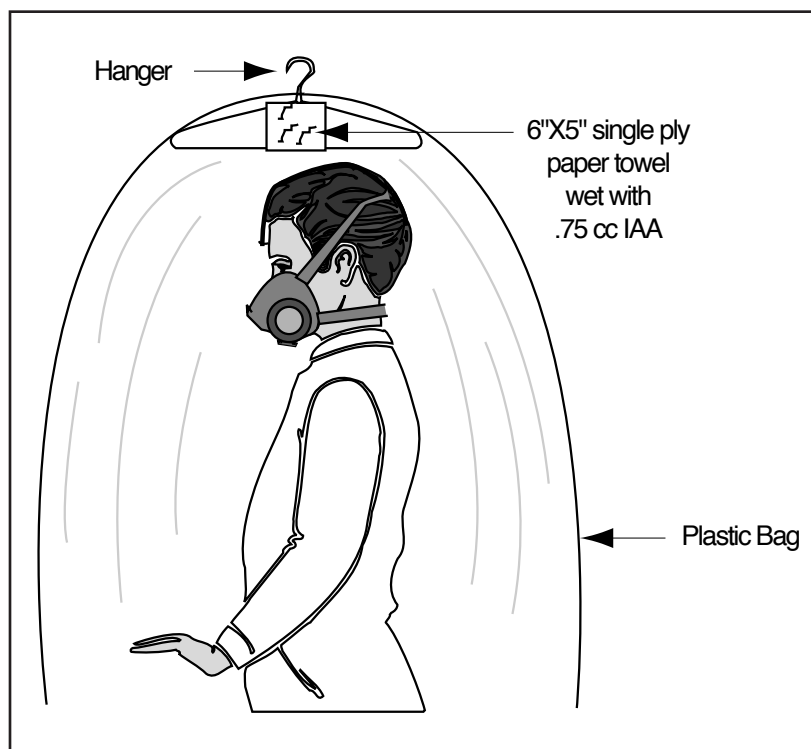
**Note:** Before performing any test, make sure the correct respirator cartridge for the testing agent has been installed.

#### Isoamyl Acetate Protocols

Isoamyl acetate (IAA) is also known as banana oil. This test requires the respirator be fitted with organic vapor cartridges or offer protection against organic vapors. The user stands inside a fit test chamber while taking this test (Figure 4-12).

In some individuals, exposure to IAA can cause the following health effects:

- Olfactory fatigue - the sense of smell is dulled
- Feelings of lightheadedness and drunkenness



**Figure 4-12.** The fit test chamber is only used with isoamyl acetate (IAA), also called banana oil.

### Irritant Smoke Test

Irritant smoke is very irritating to the eyes, nose, and throat and usually causes coughing. The worker being tested must keep his or her eyes closed during the fit test when wearing a half facepiece. This test requires the respirator be fitted with a *high efficiency particulate air (HEPA) filter* or P100 particulate filter.

### Saccharin Test

The saccharin test uses a saccharin aerosol. If saccharin leaks into the facepiece, the worker will have a sweet taste on the lips and tongue. Workers must take a taste test before using this testing agent because some people cannot taste saccharin. A small nebulizer is used to create a saccharin aerosol inside the test chamber. This test uses a particulate filter.

### Bitrex Test

The Bitrex<sup>™</sup> test is a Bitrex aerosol that has a citrus or orange flavor. The fit testing protocol for Bitrex is identical to the saccharin protocol.

**Quantitative Fit Test**

A *quantitative fit test (QNFT)* is a more sophisticated fit test. It measures the actual amount of leakage into the respirator. A variety of methods are available for performing a QNFT, and each one uses a different technology. The quantitative fit test protocols are:

- Generated aerosol – An aerosol is generated and dispersed in a room. Air monitoring instruments are used to measure both the concentration in the room and the concentration inside the actual facepiece.
- Ambient aerosol condensation nuclei counter – The amount of natural dusts in the air is measured and compared to the amount of dust inside the facepiece.
- Controlled negative pressure - Air pressure inside the facepiece is kept constant. As air leaks into the facepiece, air is exhausted to maintain the constant inside air pressure. Therefore, the exhausted air is equivalent to the amount of leakage and can be measured to determine leakage.

**RESPIRATOR USE**

The employer is required to establish and implement procedures for the proper use of respirators. These procedures are listed below:

- Prohibiting conditions that may result in facepiece seal leakage.
- Preventing workers from removing respirators in hazardous environments.
- Taking actions to ensure continued effective respirator operation throughout the work shift.
- Establishing procedures for the use of respirators in IDLH atmospheres.

**Facepiece Seal Conditions**

OSHA does not permit respirators to be worn when conditions prevent a good seal. These conditions include the following:

- Facial hair that crosses the sealing surface (stubble beard growth, beard, mustache, or sideburns)
- Skull cap that projects under the facepiece
- Temple pieces on glasses
- Absence of one or both dentures
- Facial scars or deformities that hinder a good seal

The need for a good seal is the reason facial hair is prohibited for workers who must wear respirators. Facial hair prevents the facepiece from sealing against the face and results in a high rate of leakage.

Eyeglasses pose another facepiece seal problem. The temple bars on eyeglasses prevent a respirator from sealing against the side of the head. However to go without eyeglasses creates vision-related problems, such as tripping hazards. Respirator manufacturers make fittings that hold lenses in place in the facepiece without temple bars. OSHA requires that this type of fitting be made available at the employer's expense to workers who wear glasses.

**User Seal Checks**

A respirator must be adjusted each time you put it on to ensure the best possible seal. To do this, conduct a user seal check. You can use either of the two methods listed:

1. Positive pressure seal check and negative pressure seal check
2. Manufacturer's recommended user seal check

User seal checks are **not** substitutes for qualitative or quantitative fit tests.

**Positive Pressure User Seal Check**

To perform a positive pressure user seal check, follow these steps:

1. Cover the exhalation valve of the respirator.
2. Exhale gently for about 10 seconds. Do **not** exhale too hard or push the mask into the face because the check will be inaccurate.

If the respirator fits, a slight pressure should build up inside the facepiece. If air leaks out, the respirator does not fit properly, and the seal is inadequate. Figure 4-13 illustrates a positive pressure seal check.

This test is done on a atmosphere supplying respirator by covering the inlet and exhalation valve with your hands and exhaling.

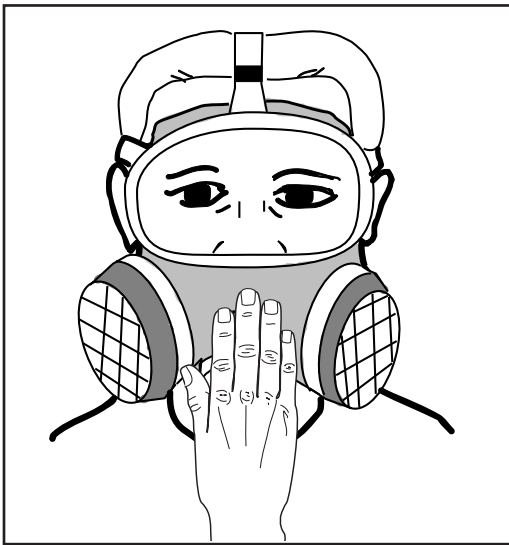
#### Negative Pressure User Seal Check

To perform a negative pressure user seal check, follow these steps:

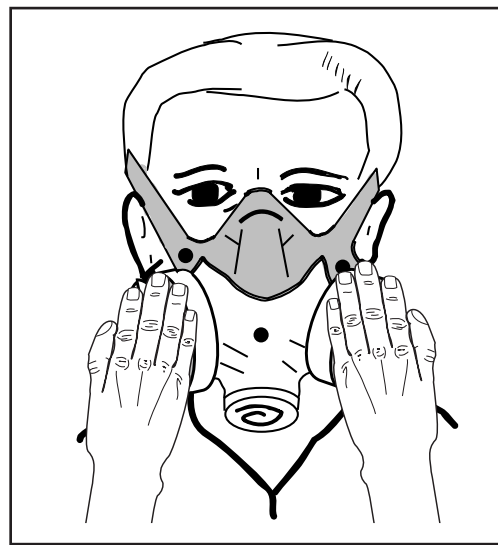
1. Cover the filter openings with the palms of your hands.
2. Inhale gently and hold your breath for about 10 seconds. Do **not** push the respirator into the face too hard, or the check will be inaccurate.

If the respirator fits correctly, the facepiece should collapse slightly inward. If the respirator does not fit correctly, the facepiece will not collapse, and you will feel an air leak (Figure 4-14).

This test is done on a atmosphere supplying respirator by covering the inlet with the hand and inhaling.



**Figure 4-13.** Cover the exhalation valve when performing a positive pressure user seal check.



**Figure 4-14.** Cover the filter openings when performing a negative pressure user seal check.

**Continued Respirator Effectiveness**

OSHA requires the employer to monitor the workplace for changes that may affect the effectiveness of the respirators. Examples include changes in work area conditions or in worker exposure or stress. When such changes occur, the employer shall reevaluate the continued effectiveness of the respirator.

If you experience any trouble with your respirator, leave the area and fix the problem. Specifically, leave the work area for any of the following conditions:

- To wash your face and respirator to prevent eye or skin irritation
- If you detect vapor or gas breakthrough
- If you experience increased breathing resistance
- If you detect a leak in the facepiece seal
- To replace the respirator or the filter, cartridge, or canister

**IDLH Conditions**

OSHA requires that additional standby worker(s) be located outside an IDLH atmosphere when a worker(s) has entered that area. The purpose of the standby worker is to assist co-workers in case of an emergency. The standby person must:

- Be trained and equipped to provide effective emergency response.
- Maintain visual, voice, or signal line of communication with worker(s) in the IDLH atmosphere.

**MAINTENANCE AND CARE**

The employer must provide for the following regarding the respirators used by workers:

- Cleaning and disinfecting
- Storage
- Inspection
- Repair

**Cleaning and Disinfecting**

It is the employer's responsibility to provide a clean and disinfected respirator to the user. A respirator issued for the exclusive use of one worker must be cleaned and disinfected by that worker to maintain the respirator in a sanitary condition. However, if a respirator is issued to more than one worker, for emergency use, or for fit testing, it must be cleaned and disinfected after each use.

**Storage**

For a respirator to remain in good condition and proper working order, it must be stored correctly to protect it from the following:

- Chemicals
- Contamination
- Damage
- Dust
- Excessive moisture
- Extreme temperatures
- Sunlight

In addition, a respirator shall be packed and stored to prevent the facepiece and exhalation valve from being deformed.

**Inspection**

All respirators must be inspected before each use and during cleaning. Atmosphere supplying respirators and respirators used for emergency purposes must be inspected monthly or according to manufacturer specifications. All written inspection records for emergency use respirators must be kept.

Air cylinders must be maintained in a fully charged state. They must be recharged when the pressure falls below 90 percent of manufacturer's recommended pressure.

Check the following items when conducting a respirator inspection:

- Function
- Connections, including tightness
- Condition of parts, especially rubber parts, for flexibility and deterioration

**Repair**

The following list outlines OSHA's requirements regarding respirator repairs:

- Repairs must be performed by a trained individual.
- Only the manufacturer's NIOSH-approved parts designed for the specific respirator shall be used.
- Repairs performed on the regulator, alarms, or admission valves of an atmosphere supplying respirator shall be performed by the manufacturer or a technician trained by the manufacturer.

**BREATHING AIR QUALITY**

Breathing air used in atmosphere supplying respirators must meet at least the requirements for Grade D breathing air as described in the *ANSI/Compressed Gas Association Commodity specifications for Air, G-7.1-1989*. Grade D air has the following limits:

- Oxygen content - 19.5 to 23.5 percent (similar to normal breathing air)
- Hydrocarbons - No greater than  $5 \text{ mg}/\text{m}^3$  of air
- Carbon monoxide - No greater than 10 *ppm*
- Carbon dioxide - No greater than 1,000 *ppm*

OSHA addresses the following issues in 29 CFR 1910.134 (i):

- Air cylinders must be tested and meet minimum standards to ensure they can be safely pressurized.
- Air line couplings must be incompatible with outlets for other gases. This incompatibility prevents injury caused by the accidental use of other gases.
- Compressors used for air line systems must have built-in safety devices. These include:
  - Air purifying filters
  - Alarms for compressor failure
  - Alarms for overheating and high carbon monoxide levels
  - Reserve air systems to provide back-up air in the case of compressor failure
- Compressed oxygen shall **not** be used in open circuit atmosphere supplying respirators.

**Note:** Compressors used for pneumatic tools must not be used for air line systems. The air contains carbon monoxide, making it unbreathable and dangerous.

## TRAINING

The respiratory protection standard requires that the employer provide effective training to workers who are required to use respirators. Training must be:

- Given to workers before they begin using respirators
- Understandable to the worker
- Comprehensive enough that it covers all required items
- Provided annually or more often if necessary

Workers who voluntarily wear a respirator shall be given the information located in 29 CFR 1910.134 appendix D. This information can be given written or verbally.

An employer must ensure that workers can demonstrate knowledge in the following topics:

- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator.
- Limitations and capabilities of the respirator.
- How to use the respirator in an emergency situation.
- How to inspect, don, doff, use, and seal check the respirator.
- Procedures for maintaining and storing the respirator.
- How to recognize medical signs and symptoms that may limit or prevent the effective use of the respirator.

Retraining shall be done every year, or sooner, for the following reasons:

- Changes in the workplace or type of respirator render the old training ineffective.
- A worker does not retain information from the initial course.
- Any other situation occurs in which retraining appears necessary to ensure safe respirator use.

## **PROGRAM EVALUATION**

The employer is required to evaluate the written respiratory protection program as necessary to ensure it is being properly implemented and is effective. The evaluation shall include consulting workers who use respirators for their views on program effectiveness as well as problems.

## **RECORDKEEPING**

The employer must establish and retain written information regarding the following:

- Exposure assessments
- Medical evaluations
- Respirator inspections
- Written respirator program

## **Fit Testing Records**

Qualitative and quantitative fit testing records also must be kept. They must be retained until the worker's next fit test. These records shall contain the following:

- Name of the worker tested
- Type of fit test performed
- Make, model style, and size of the respirator tested
- Test date
- Test results -
  - Pass/fail results of qualitative fit tests
  - Fit factor and strip chart recording
  - Other recordings of test results for QNFTs

## **Training Records**

Written documentation of worker respirator training and respirator program evaluation results shall also be maintained.

**CHEMICAL  
PROTECTIVE  
CLOTHING**

Chemical protective clothing (*CPC*) is commonly used on waste site jobs to protect workers against skin exposures to chemicals. Although inhalation is the most common route of entry and has the highest potential for chemical exposure, being aware of skin exposure is also important. Some chemicals burn or irritate the skin. Other chemicals are absorbed without causing any warning pain or redness. Once these chemicals are absorbed into the skin, they are capable of causing damage to other organs, such as the liver or nervous system.

**Types of Chemical  
Protective Clothing**

There are many different types CPC available. Examples of CPC include:

- Whole body protective suits
- Gloves
- Boots
- Face shields and goggles

Table 4-5 summarizes the different materials used to manufacture CPC.

**Whole Body Protection  
Suits**

Whole body protection suits can either be fully encapsulating suits or splash suits. Fully encapsulating suits protect workers from chemical splashes, gases, and vapors. The word encapsulate means to totally enclose, as if in a capsule. These are used with supplied air respirators so that a sealed environment is created which keeps out contaminants in any form. A fully encapsulated suit with SCBA can weigh up to 50 pounds.

A one piece whole body suit, similar to a coverall, provides better protection than a two piece suit because two piece suit has an opening between the jacket and pants. In addition, most one piece body suits have hoods.

Splash suits are nonencapsulating suits. They usually consist of a jacket and hood in combination with a pair of pants or bib overalls. This type of suit provides protection from chemical splashes only. A splash suit is usually worn with protective boots, gloves, and a respirator. Duct tape is used to seal the overlap between sleeves and gloves, and suit legs and boots.

**Table 4- 5.** A summary of the materials used for chemical protective clothing.

<b>Material</b>	<b>Description</b>
Butyl Rubber	Man-made rubber. Resistant to many chemicals. Low resistance to petroleum-based solvents and halogenated hydrocarbons. Relatively expensive. Used in boots, gloves, aprons, splash suits, and fully encapsulating suits.
Chloropel	A plastic material. Also called CPE, chlorinated polyethylene, or polychloroprene. Resistant to some chemicals. Used in splash suits and fully encapsulating suits.
Natural Rubber	Natural rubber from rubber trees. Resistant to acids, caustics, alcohols, and oils. Inexpensive. Used for boots, gloves, and respirator facepieces and hoses.
Nitrile	Synthetic rubber. Also referred to as BUNA-N, NBR, milled nitrile, and nitrile latex. Resistant to acids, caustics, alcohols, gasoline, and some petroleum and halogenated solvents. Inexpensive. Used in boots and gloves.
Nomex®	Man-made fiber material. Resistant to acids. Provides protection from high temperatures. Durable. Used in firefighters turnout gear and as a base for rubber in some fully encapsulating suits.
Polyethylene	A plastic. Used as a covering for some disposable suits, because it increases the resistance against acids, caustics, and salts. Also used for disposable suits, gloves and boots.
Polyvinyl Alcohol	A plastic material. Also called PVA. Excellent resistance to aromatic and halogenated solvents. Not resistant to water or water-based chemicals. Used for gloves.
Polyvinyl Chloride	A plastic material. Also called PVC. Resistant to acids and caustics. Used in boots, gloves, aprons, splash suits, and fully encapsulating suits.
Saranex®	A plastic (same plastic as in Saran Wrap®). Used with disposable materials such as Tyvek®. Used as a general purpose material for disposable suits, boots, and gloves.
Tyvek®	A plastic fiber. Reasonable puncture and abrasion resistance. Good resistance to particulates. Used to make disposable suits to protect against asbestos. Low protection from chemicals by itself. Chemical resistance is increased when coated with materials, such as polyethylene and Saranex. Inexpensive. Used for disposable garments.
Viton	A plastic material similar to Teflon®. Provides excellent resistance to petroleum and halogenated solvents (chemicals that permeate many other types of materials). Expensive. Used for gloves and fully encapsulating suits.

## Gloves

Hands are the most likely body part to come into contact with chemicals, so gloves are critical for worker protection. Gloves come in different materials and thicknesses. The ability of a glove to withstand chemical permeation is very important. In many situations, it is common to wear more than one pair of gloves.

Outer gloves are usually used to protect more expensive chemical resistant gloves from damage due to abrasion, puncture, and rips. Often these outer gloves are disposable because once gloves are contaminated on the outside, it is very difficult to clean them. Depending on the type of glove material, contamination will eventually permeate through. Once glove breakthrough has occurred, the gloves become a source of exposure to the worker. Because of this possibility, strict rules must be set as to when gloves are discarded. Inexpensive gloves are discarded after each use. More expensive gloves are discarded regularly, but less often and usually on a schedule established by the safety and health officer (*S&HO*) or industrial hygienist.

One problem area with gloves is that chemicals can get into the glove cuffs if care is not taken. To solve this problem, gloves with extra long sleeves are sometimes used. Also, care must be taken to put the jacket sleeves over the glove cuffs. Then, the sleeves are sealed to the gloves with tape. An additional pair of vinyl or latex inner disposable gloves may also be used.

## Boots

Boots made from chemical resistant materials protect the feet from chemical contact. They are available in a wide range of materials. Boot plastic is much thicker than glove material, so permeation is less of a problem. However, eventually boots must also be discarded. Disposable boot covers are commonly used to minimize the contamination. The boot covers are discarded after each use.

Boots must also function as safety shoes because the waste site often has typical construction hazards to the feet. Chemical resistant boots are available with reinforced toe, shank, and insole guards to meet safety shoe standards. On some jobs, special boots with spark-

proof bottoms are needed. These boots protect the worker from electrical hazards and they prevent accidental ignition of flammable gases and vapors.

#### Face Shields and Goggles

When full-face respirators are used, the face and eyes are protected. However when wearing half-face respirators, face shields or goggles are used to protect the face from chemicals. The face shield and goggles must not interfere with the respirator's seal.

#### Leakage Issues

Like respirators, CPC has limitations. The biggest limitation is leakage. For respirators, much of the leakage has to do with how well the mask fits. For gloves and protective clothing, the leakage has more to do with chemicals passing through the protective barrier of the clothing. In this way, the leakage issue is like the issue of chemical breakthrough with respirator filters. There are three important terms to know about when discussing leakage and the protection offered by CPC:

1. Permeation
2. Degradation
3. Penetration

#### Permeation

*Permeation* is the process by which a chemical passes into the chemical structure of the material and through to the other side. Although chemical protective clothing definitely provides a barrier, some chemicals can eventually pass through. The length of time it takes a chemical to permeate depends on the chemical's properties. Chemical permeation may not be detected by looking at a piece of protective clothing.

#### Degradation

*Degradation* is the process by which a chemical changes the protective material so that it loses its effectiveness as a barrier. (The chemical breaks down the clothing material.) Sometimes degradation can be seen. For example, the material may be puckered, brittle, and eroded. Chemicals, sunlight, and high temperatures all can cause degradation.

#### Penetration

*Penetration* is the ability of a chemical to pass through a garment by way of openings in the material. Examples include pin holes, imperfections in the material, zippers, and seams.

Data is available from the manufacturer on permeation and degradation of CPC. However, a scoring system, like PFs for respirators, does not yet exist for CPC. Most protective clothing manufacturers do issue permeation guides for their products. Because different types of plastic and rubber provide different levels of resistance against permeation and degradation, manufacturers make gloves and suits out of several types of materials.

## **NONCHEMICAL PROTECTIVE CLOTHING**

There can be other types of hazards on a waste site or spill scene other than chemicals. For nonchemical hazards there are specialized types of PPE, such as:

- Firefighting gear
- Proximity or approach garments
- Blast and fragmentation suits
- Flotation gear
- Cooling garments

### **Firefighting Gear**

Firefighting gear includes a helmet, a running or bunker coat, and running or bunker pants. This gear is designed to protect against high temperatures. It is not as resistant to chemical splashes or permeation, and it does not seal out vapors.

### **Proximity or Approach Garments**

Proximity or approach garments are designed to protect against brief exposures to very high radiant heat. It is normally worn over other protective clothing. Firefighters use these garments to approach intense fires. It provides some protection from chemical splashes, but no protection from vapors.

### **Blast and Fragmentation Suits**

A blast and fragmentation suit works like a bullet-proof vest. It provides the wearer with limited protection from explosions. Bomb blankets and other equipment must sometimes be used to provide additional protection. In addition, these suits provide some protection from chemical splashes.

### **Flotation Gear**

The heavy weight of most PPE creates its own hazard when working on or near water. There is an increased risk of drowning. Because of this, life-jacket type gear shall be worn with CPC.

**Cooling Garments**

Heat stress is a hazard when wearing PPE in warm weather and/or doing vigorous work. There are three different types of cooling devices that have been developed for use in special situations.

- Cool air systems - use a pump to circulate cool dry air throughout the protective suits.
- Cool vests - use a jacket or vest with pockets for holding packets of ice or other frozen material.
- Chilled water units - use a small, battery-operated pump to circulate chilled water through tubes which cover the upper part of the body.

**PROTECTIVE  
ENSEMBLES**

There are few situations where a worker will use protective clothing without a respirator or a respirator without protective clothing. Usually, a specific respirator is paired with a type of protective clothing, and the whole outfit is called an *ensemble*. Occupational health specialists working on hazardous waste sites have developed four ensembles—Level A, B, C, and D. Detailed profiles of all four levels are in Appendix 4-1.

Level A is the highest level of protection available, and consists of a fully-encapsulating, vapor and gas-proof suit with an atmosphere supplying respirator. It is used when chemical exposures are expected to be high.

Level B provides the same respiratory protection as Level A, but uses a chemical splash suit that provides moderate skin protection. It can be used when the vapor or gas levels are not high enough to be a hazard to the skin. Level B is the minimum level of protection when the contaminants are unknown.

Level C uses a chemical splash suit and a full-face APR. It's used when airborne chemical levels are reliably known and adequate chemical filters are available.

Level D is the lowest level of protection. No respirator is used, and skin protection is minimal.

**Determining the PPE Level**

The hazard assessment carried out during development of the Site Safety and Health Plan establishes the levels of PPE to be used during the cleanup. But a site hazard assessment is an ongoing task. Thus changes are made, especially as the job progresses. For example, there may be a hazardous work area on site that requires Level A. Once that work area is done, workers may move onto the next section that only requires Level C. The S&HO is responsible for making PPE decisions. Typical factors considered for a change to a lower PPE level are:

- New information showing less hazardous conditions
- Change in site conditions that reduces the hazard
- Change in task that reduces contact with hazardous materials

Factors considered for changing to a higher PPE level are:

- Known or suspected skin hazards
- Likely occurrence of gas or vapors being given off
- Change in task that increases contact with hazardous materials
- Worker request

Levels A to D are the basic ensembles used on hazardous waste jobs.

**USING PERSONAL PROTECTIVE EQUIPMENT**

Training is critical to the safe and proper use of PPE for the following reasons:

- Workers become familiar with PPE operation in a safe environment.
- Workers learn their own limitations when wearing PPE.
- A worker becomes more skilled at doing a job while wearing PPE.
- Needless wear and tear on the PPE is reduced.
- Accidental exposures on the job are reduced.

Even though this course provides experience with PPE, site specific training is important. There may be important differences between manufacturers.

### **Work Mission Duration**

Many different factors must be considered in planning how work will be done, and how long each work mission will take. On a typical construction job, a work shift is eight hours long, with breaks and lunch along the way. But the structure of a work day on a waste site is very different, especially if SCBAs are used. On a waste site, jobs must be divided into missions to match the length of time the air supply will last. Workers need to allow at least enough time to do the following:

1. Put the respirator on
2. Travel to the job area from the dress out area
3. Return to the decontamination area and be decontaminated

Work time is the amount of time left after factoring in the above actions. So the actual work task must be well planned. However, several factors can affect the length of work time. They include:

- Work rate
- Fitness level
- Body size
- Breathing patterns
- Outside temperatures
- Coolant supply

### **Work Rate**

The more strenuous the work, the faster and heavier a worker breathes. The air supply is used up quicker, and the work time is reduced. Heavy work reduces the in-use duration of SCBAs by 1/3 to 1/2. In other words, 30 minutes of air is reduced to 20 or 15 minutes of air.

### **Fitness Level**

The better the physical shape a worker is in, the more oxygen the body uses from a given amount of air. Their systems are more efficient. Therefore, an air supply will last a bit longer for more physically fit workers.

### **Body Size**

Larger workers normally use air faster than smaller workers.

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Breathing Patterns	Quick, shallow, irregular breathing uses air more quickly than deep, regular breaths. Workers who become sick, anxious, or uncomfortable use air more quickly.
Outside Temperatures	<p>Workers who are heat stressed may breath faster, so they use air at a faster rate. Also hot and cold temperatures can affect how well the suit and respirator work which then affects the work mission. The following are examples:</p> <ul style="list-style-type: none"><li>• Valves on suits and masks may not operate as well</li><li>• Suits may become less durable or flexible</li><li>• Fasteners may not work well</li><li>• Chemical breakthrough times may be affected</li><li>• Airborne chemical levels may be affected</li></ul>
Coolant Supply	Sometimes cooling units are used under warm or strenuous conditions. So the coolant supply time can also limit the duration of the work mission.
<b>Personal Use Factors</b>	<p>Several items can affect the protection provided by PPE. It's important that workers are aware of these items. They include the following:</p> <ul style="list-style-type: none"><li>• Facial hair</li><li>• Long hair</li><li>• Eyeglasses</li><li>• Contact lenses</li><li>• Gum and tobacco chewing</li></ul>
Facial Hair	A beard or long sideburns prevent a good seal between the face and the respirator. Studies have shown that any facial hair reduces the protection received from a respirator. This includes a full beard, as well as a few days growth. A mustache is acceptable if it fits under the mask without affecting the seal.
Long Hair	Long hair may interfere with a good seal in some situations. The hair must be contained under the protective suit.
Eyeglasses	The temple bars that extend from the ear to the lens prevent the respirator from fitting up against the side of the head. Spectacle kits take care of this situation quite easily. They are inexpensive, and must be provided by

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the employer. Under no condition should workers hesitate to request a spectacle kit. To work without eyeglasses creates a serious potential for accident and injury.

#### Contact Lenses

Contact lenses cannot be used with a respirator in a contaminated atmosphere for the following reasons:

- A contact lens is porous. It can absorb chemicals causing the chemicals to contact the eye. This can lead to eye injury.
- Sometimes the humidity inside the mask can be very low or very high. The degree of humidity affects the ability to wear contact lens comfortably.
- If the lenses were to pop out of the eye in a hazardous area, the worker might be put into a dangerous situation. There would be no way to put the lens back in without taking off the respirator.

#### Gum and Tobacco Chewing

Gum and tobacco chewing are prohibited when wearing a respirator. The chewing action puts a strain on the respirator seal. It could also lead to ingestion of contaminants.

#### Donning and Doffing

*Donning* is the act of putting on PPE. It's not difficult to put on the equipment. However, a specific routine must be followed for the best results. Assistance is usually provided by another worker, especially if a fully encapsulating suit and SCBA is involved. Donning procedures for Levels A, B, and C are given in the SOPs at the end of the section.

*Doffing* is the act of removing PPE. Again, it is important to follow the specific steps when removing PPE. Doffing is made more complicated by the fact that the PPE may be contaminated. (Procedures for doffing PPE are discussed in the Decontamination section of this manual.)

**In-Use Monitoring**

When wearing PPE, workers should be alert to conditions that signal chemical exposure has occurred. These conditions include the following:

- Signs that the protective ensemble has been degraded in any way
- Chemical odors
- Skin irritation
- Unusual fatigue
- Breathing difficulties
- Vision problems
- Restrictions in the ability to move
- Physical discomfort, rapid pulse, nausea, or chest pain

**INSPECTIONS**

Inspection are an important part of a good PPE program. Checklists and written records are needed to verify and maintain the effectiveness and safety of the PPE. There are different types of inspections.

1. Inspection and testing of new equipment
2. Inspection of equipment at the time it is issued to workers
3. Inspection after use
4. Periodic inspection of stored equipment
5. Inspection when problems are reported

The responsibility to inspect PPE must be assigned to a specific qualified person. However, it is a good practice for workers to know how to do a basic equipment inspection. Inspection guideline are provided in Appendix 4-2.



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**SECTION 4 - ASSIGNMENT SHEET**

1. Define the following terms:

Degradation \_\_\_\_\_

\_\_\_\_\_

Maximum use concentration \_\_\_\_\_

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Permeation \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Penetration \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Protection factor \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Qualitative fit test \_\_\_\_\_

\_\_\_\_\_

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Quantitative fit test \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2. Write out the following abbreviations:

APR \_\_\_\_\_  
CPC \_\_\_\_\_  
MUC \_\_\_\_\_  
PAPR \_\_\_\_\_  
PPE \_\_\_\_\_  
SCBA \_\_\_\_\_

3. List the five types of respirators and their protection factors.

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4. List the eight limitations of a half-face APR.

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5. List the limitations of a full-face air line respirator.

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6. List the limitations of SCBAs.

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7. List the PPE used in Level A.

Protective clothing:

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Respirator:

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8. List the PPE used in Level B.

Protective clothing:

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Respirator:

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9. List the PPE used in Level C.

Protective clothing:

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Respirator:

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10. List the PPE used in Level D.

Protective clothing:

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Respirator:

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**SECTION 4 - STANDARD OPERATING PROCEDURE 1****Half-face APR**

- A. Inspect the half-face APR. Check all parts for signs of dirt, wear, tears, and integrity. Ensure all parts can and will work properly by using the following steps.
1. General appearance (no deformities).
  2. Harness and strap assemblies.
  3. Facepiece seal area.
  4. Nose cup.
  5. Inhalation valves.
  6. Exhalation valve, valve seats and cover.
  7. Filter or cartridge holder and gaskets.
  8. Filter(s) or cartridge(s).
  9. Install proper filter(s) or cartridge(s).
- B. Don a half-face APR using the following steps.
1. Inspect the respirator.
  2. Loosen the harness assembly completely.
  3. Hang the facepiece around the neck using the neck strap (if available).
  4. Raise the facepiece upward and open exposing the chin and nose cup.
  5. Place chin in the chin cup and pull the harness over the top of the head.  
Make sure there is no hair or other obstructions between the face and facepiece.
  6. Tighten the bottom two harness straps (not too tight).
  7. Tighten the top strap slightly.
  8. Adjust facepiece if needed. (It should be centered on the face.)
- C. Perform a negative pressure check with the half-face APR.
1. Inspect the respirator.
  2. Don the respirator.
  3. Cover the filter or cartridge inlet openings. The palms of the hands, duct tape, plastic wrap, or surgeon's gloves may be used.
  4. Inhale so the facepiece collapses inward and hold for ten seconds.
  5. If the facepiece stays collapsed, continue with step 7.
  6. If there is leakage, readjust the facepiece and try again. If there is still leakage, re-inspect the respirator and try again. If it's still not possible to get a seal, try a different size or make of respirator.
  7. Remove the coverings from the filter or cartridge inlets.

- D. Perform a positive pressure check with the half-face APR.
1. Inspect the respirator.
  2. Don the respirator.
  3. Cover the exhalation outlet. The palm of the hand, duct tape, plastic wrap, or surgeon's gloves may be used.
  4. Exhale so that the facepiece is enlarged slightly and hold for ten seconds.
  5. If the facepiece stays enlarged, continue with step 7.
  6. If there is leakage, readjust the facepiece and try again. If there is still leakage, re-inspect the respirator and try again. If it is still not possible to get a seal, try a different size or make of respirator.
  7. Remove the coverings from the exhalation outlet.
- E. Clean, sanitize, and maintain a half-face APR using the following steps.
1. Remove and properly discard filters and/or cartridges.
  2. Immerse the respirator in a warm (about 110°F/43.3°C) solution of germicidal or disinfecting detergent.
  3. Scrub the respirator body and parts gently with a cloth or soft brush.
  4. Rinse in clean, warm (about 110° F/43.3°C) water.
  5. Shake gently to remove excess water. It may be necessary to tip the respirator several directions.
  6. Wipe the respirator with a soft, clean cloth (if available) or allow to air dry away from direct heat or sunlight.
  7. Inspect the respirator.
  8. Replace all damaged or missing parts according to the manufacturer's instructions.
  9. Loosen harness straps.
  10. Place respirator in a clean bag, box, or appropriate storage area. The storage area should be in a cool, dry place. Do not place any weight on the respirator.

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**SECTION 4 - STANDARD OPERATING PROCEDURE 2**

- A. Inspect a full-face APR using the following 10 steps. Check for signs of wear, dirt, and integrity. Check to ensure that all parts work properly.
1. Overall general appearance (no deformities).
  2. Harness assembly and connections.
  3. Lens and lens gasket.
  4. Facepiece seal area.
  5. Inner nose cup.
  6. Inhalation valves and their seating surfaces.
  7. Exhalation valves and its seating surface.
  8. Filter or cartridge holder and gaskets.
  9. Filter(s) or cartridge(s).
  10. Install proper filter(s) or cartridge(s).
- B. Don a full-face APR using the following steps.
1. Inspect the respirator.
  2. Loosen the harness assembly completely.
  3. Hang the facepiece around the neck using neck strap (if available).
  4. Raise the facepiece upward and open to expose the chin and nose cup.
  5. Place chin in the chin cup and pull the harness over the top of the head. Make sure no hair or other obstructions are between the face and facepiece.
  6. Tighten the bottom harness straps (not to tight).
  7. Tighten the middle two harness straps.
  8. Tighten the top strap slightly.
  9. Adjust the facepiece if needed. (It should be centered on the face.)
- C. Perform a negative pressure check with a full-face APR.
1. Inspect the respirator.
  2. Don the respirator.
  3. Cover the filter or cartridge inlet openings. The palms of the hands, duct tape, plastic wrap, or surgeon's gloves may be used.
  4. Inhale so the facepiece collapses inward and hold for ten seconds.
  5. If the facepiece stays collapsed, go to step 7.
  6. If there is leakage, re-adjust the facepiece and try again. If there is still leakage, re-inspect the respirator and try again. If it is still not possible to get a seal, try a different size or make of respirator.
  7. Remove the coverings from the filter or cartridge inlets.

- D. Perform a positive pressure check with a full-face APR.
1. Inspect the respirator.
  2. Don the respirator.
  3. Cover the exhalation outlet. The palm of the hand, duct tape, plastic wrap, or surgeon's gloves may be used.
  4. Exhale so that the facepiece is enlarged slightly and hold for ten seconds.
  5. If the facepiece stays enlarged, go to step 7.
  6. If there is leakage, readjust the facepiece and try again. If there is still leakage, reinspect the respirator and try again. If it is still not possible to get a seal, try a different size or make of respirator.
  7. Remove the coverings from the exhalation outlet.

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**SECTION 4 - STANDARD OPERATING PROCEDURE 3**

- A. Complete an irritant smoke or banana oil qualitative fit test using the following steps:

*Irritant Smoke*

1. Smell a weak concentration of the test agent.
2. Inspect the respirator.
3. Don the respirator.
4. Perform a negative pressure check.
5. Perform a positive pressure check.
6. Wear the respirator for at least 5 minutes.
7. Step into the test chamber or bag.
8. Close eyes.
9. Breathe normally.
10. Breathe deeply. Breaths must be deep and regular.
11. Turn head from side to side.
12. Nod head up and down.
13. Read the Rainbow passage.
14. Jog in place.
15. Breathe normally.
16. If the test agent is detected, get out of the test chamber and re-adjust the mask. Repeat steps 4 through 15.
17. If the test agent is still detected, select another size or type respirator and repeat steps 2 through 15.
18. Clean, sanitize, and maintain the respirator.

*Banana Oil*

1. Read the following instructions which will be typed on a card and placed on the table in front of the two test jars (1 and 2).

“The purpose of this test is to determine if you can smell banana oil at a low concentration. The two jars in front of you contain water. One of these jars also contains a small amount of banana oil. Be sure the covers are on tight, then shake each jar for two seconds. Unscrew the lid of each jar, one at a time, and sniff at the mouth of the jar. Indicate to the test conductor which jar contains banana oil.”
2. Make sure each of the covers are on tight and shake each jar for two seconds.
3. Unscrew the lid of each jar one at a time, and sniff at the mouth of the jar.

4. Indicate to the person conducting the test which jar contains the banana oil.
5. If you are unable to correctly identify the jar containing the odor test solution, the IAA QLFT may not be used.
6. If you correctly identify the jar containing the odor test solution, you may proceed to step 7.
7. Select the most comfortable respirator from the various sizes and manufacturers by holding each facepiece up to your face and eliminate those which are obviously not giving a comfortable fit. Normally, selection will begin with a half-mask and if a fit cannot be found here, go to the full facepiece respirators. (A small percentage of users will not be able to wear any half-mask.) Each respirator represents a different size and shape and if fit properly, will provide adequate protection. The selection process shall be conducted in a room separate from the fit-test chamber to prevent odor fatigue. A mirror shall be available to assist you in evaluation the fit and positioning of the respirator.
8. Inspect the chosen respirator, making sure that it is equipped with organic vapor cartridges. Don and wear the most comfortable mask for at least five minutes to assess comfort. Assess comfort by discussing and reviewing the following points with your instructor(s).
  - Chin properly placed
  - Positioning of mask on nose
  - Strap tension
  - Fit across nose bridge
  - Room for safety glasses
  - Distance from nose to chin
  - Room to talk
  - Tendency to slip
  - Cheeks filled out
  - Self-observation in mirror
  - Adequate time for assessment
9. If you are not familiar with using a particular respirator, your instructor(s) will help you inspect and then don the mask several times and adjust the straps each time, so that you set the proper tension on the straps.
10. After selecting, donning, and properly adjusting a respirator, “seat” the mask by rapidly moving the head side to side and up and down, taking a few deep breaths.
11. Conduct the conventional negative and positive pressure fit checks (e.g., see ANSI Z88.2-2980).
12. Wear the respirator for at least 10 minutes before starting the fit test.

13. Enter the fit test room, get a 6 x 5 inch (15.2 x 12.7 cm) piece of paper towel or other porous absorbent single-ply material, folded in half and wetted with three-quarters on one cc of pure IAA from the instructor. Hang the wet towel on the hook at the top of the chamber.
14. Allow two minutes for the IAA test concentration to be reached before starting the fit-testing exercises. Read the test exercises that are taped to the inside of the test chamber. Use this time to ask the instructor(s) any questions you may have or to have the exercises demonstrated.
15. Perform the following test exercises for at least one minute each.

*Test Exercises*

- a. Normal breathing.
- b. Deep breathing. Be certain breaths are deep and regular.
- c. Turn head from side to side. Be certain movement is complete. Do not bump the respirator on your shoulders. Inhale when the head is at either side.
- d. Nod head up and down. Be certain motions are complete and made about every second. Do not bump the respirator on your chest. Inhale when your head is in the full up position.
- e. Talking. Talk aloud and slowly for several minutes. Read the following Rainbow Passage. Reading it will result in a wide range of facial movements, and thus be useful to satisfy this requirement.

“When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.”

16. If at any time during the test, you detect the banana-like odor of IAA, quickly exit the test chamber and leave the test area to avoid olfactory fatigue.
17. If you have detected the odor, return to the selection room and remove the respirator. Repeat the odor sensitivity test and select another respirator. If you cannot be fitted with the selection of half-mask respirators, include full facepiece models in your selection process. Return to the test by starting at step 8 above.

18. If you complete the test without detecting the banana-like odor, break the face seal and take a breath before exiting the chamber. This demonstrates the efficiency of the respirator.
19. Remove the saturated towel from the hook, leave the test chamber, and return the towel to the instructor(s).
20. If you successfully passed this fit test, you may be assigned the use of the tested respirator in atmospheres with up to 10 times the PEL. In other words, this IAA protocol may be used to assign a protection factor no higher than 10.
21. After passing the fit test, assess the comfort of the respirator by using the steps outlined above. If it has become uncomfortable, another model of respirator shall be tried and tested.

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**SECTION 4 - STANDARD OPERATING PROCEDURE 4**

- A. Clean, sanitize, and maintain a full-face APR using the following steps.
1. Remove and properly discard filters and/or cartridges.
  2. Immerse the respirator in a warm (about 110°F/43.3°C) solution of germicidal or disinfecting detergent.
  3. Scrub respirator body and parts gently with a cloth or soft brush.
  4. Rinse in clean, warm (about 110°F/43.3°C) water.
  5. Shake gently to remove excess water. It may be necessary to tip the respirator several directions.
  6. Wipe the lens and respirator with a soft, clean cloth (if available) or allow to air dry away from direct heat or sunlight.
  7. Inspect the respirator.
  8. Replace all damaged or missing parts according to the manufacturer's instructions.
  9. Loosen harness straps.
  10. Place respirator in a clean bag, box, or appropriate storage area. The storage area should be in a cool, dry place. Do not place any weight on the respirator.

**SECTION 4 - STANDARD OPERATING PROCEDURE 5**

A. Inspect a full-face atmosphere supplying respirator using the following steps:

1. Check all hoses and lines for signs of excessive wear or abuse. Do not use if there is a doubt.
2. Inspect the manifold assembly for integrity.
3. Inspect the breathing valve for integrity.
4. Check the air supply from the manifold to the respirator. It should be between 60 - 125 psi.
5. Inspect the facepiece.

B. Don a full-face atmosphere supplying respirator using the following steps:

1. Inspect the air line respirator.
2. Adjust the waist straps and buckle (be sure the straps are not twisted).
3. Make sure the positive pressure is off if there is a donning valve.
4. Hang the head strap over the neck.
5. Make the proper connections to the air supply and manifold.
6. Don the facepiece.
7. Do a positive pressure (two-finger) check.
8. Do a negative pressure check (optional).
9. Check the bypass valve to make sure its working properly.

C. Clean, maintain, and store a full-face atmosphere supplying respirator using the following steps:

1. Turn off the positive pressure.
2. If needed, clean the apparatus with a brush and mild detergent.
3. Rinse well and towel or air dry.
4. Unscrew the breathing hose at the manifold end.
5. Remove the cover on the facepiece by unscrewing the two screws and pulling off the cover.
6. Remove the breathing valve by twisting the valve clockwise, disconnecting the bayonet coupling.
7. Cover the inhalation side of the valve with your thumb and immerse the breathing valve in a warm (about 110°F/43.3°C) solution of germicidal or disinfecting detergent. Do not allow water into the inhalation side of the valve!
8. Immerse the breathing valve (again covering the inhalation side) in clean warm water and rinse.

9. Gently shake the valve to remove excess water. Wipe with a clean soft cloth and allow to air dry.
10. Immerse the facepiece in the warm germicidal or disinfecting solution.
11. Gently scrub with a cloth or soft brush.
12. Rinse in clean warm water.
13. Shake gently to remove excess water.
14. Wipe the lens and facepiece with a soft cloth or allow to air dry away from direct heat or sunlight.
15. Inspect the air line respirator and facepiece.
16. Connect the breathing valve to the facepiece by pushing and turning counterclockwise to engage the bayonet coupling.
17. Lock the breathing valve in position with the cover, speech diaphragm, or radio attachment by tightening the locking screws.
18. Connect the breathing hose to the manifold.
19. Store the apparatus in its case or in a clean, dry, dust-free area.

**SECTION 4 - STANDARD OPERATING PROCEDURE 6**

- A. Inspect, maintain, and store the PPE used in Level D including:
1. Coveralls.
  2. Safety boots/shoes.
  3. Safety glasses or chemical splash goggles.
  4. Hard hat.
- B. Inspect, maintain, and store the PPE used in Level C.
1. Inspect, maintain, and store a full-face APR.
  2. Inspect the chemical protective suit by looking for cuts, abrasions, tears, and holes. Pay close attention to seams and zippers. If in doubt about the integrity of the suit, contact a supervisor.
  3. Inspect gloves and boots by repeating the inspection used for suits, then blow into the boots and gloves and hold them under water. If there are bubbles or breaks, contact a supervisor.
  4. Store all equipment in a clean, dry, dust-free area away from direct heat or sunlight.
- C. Don the PPE used in Level C.
1. Coveralls can be worn under the Level C Suit.
  2. Monitor your pulse, temperature, and weight.
  3. Put on boots and inner gloves.
  4. Don the chemical protective suit. Make sure to fasten all fasteners.
  5. Don the full-face APR.
  6. Perform a negative pressure check.
  7. Perform a positive pressure check.
  8. Put head coverings on if available.
  9. Put on outer boots and outer gloves. Duct tape may be used to secure the suit, gloves, and boots. Make sure the suit is over the tops of the boots and gloves.
- D. Inspect, maintain, and store the PPE used in Level B using the following steps:
1. Inspect, maintain, and store an atmosphere supplying respirator.
  2. Inspect the chemical protective suit by looking for cuts, abrasions, tears, and holes. Pay close attention to seams and zippers. If in doubt about the integrity of the suit, contact a supervisor.
  3. Inspect gloves and boots by repeating the inspection used for suits, then blow into the boots and gloves and hold them under water. If there are bubbles or leaks, contact a supervisor.
  4. Store all equipment in a clean, dry, dust-free area away from direct heat or sunlight.

- E. Don the PPE used in Level B (buddy needed) using the following steps:
1. Coveralls can be worn under a Level B Suit.
  2. Monitor your pulse, temperature, and weight.
  3. Put on inner-boots (if needed) and inner-gloves.
  4. Don the chemical protective suit. Make sure to fasten all fasteners.
  5. Don the atmosphere supplying respirator except for the facepiece.
  6. Put on outer boots and outer gloves. Duct tape may be used to secure the suit, boots, and gloves. Make sure the suit is over the top of the gloves and boots.
  7. Don the facepiece.
  8. Perform a positive pressure (two-finger) check.
  9. Perform a negative pressure check (optional).
- F. Inspect, maintain, and store the PPE used in Level A using the following steps:
1. Inspect, maintain, and store an atmosphere supplying respirator.
  2. Inspect the fully encapsulated suit by looking for cuts, abrasions, tears, and holes. Pay close attention to seams and zippers. If in doubt about the integrity of the suit, contact a supervisor or do a pressure check following the manufacturer's instructions.
  3. Inspect gloves and boots by repeating the inspection used for suits, then blow into the boots and gloves and hold them under water. If there are bubbles or leaks, contact a supervisor.
  4. Store all equipment in a clean, dry, dust-free area away from direct heat or sunlight.
- G. Don the PPE used in Level A (buddy needed) using the following steps.
1. Coveralls can be worn under Level A suits.
  2. Monitor your pulse, temperature, and weight.
  3. Put on inner-boots (if needed) and inner-gloves.
  4. Don the fully-encapsulated suit to the waist only. Put the leg opposite the zipper in first.
  5. Don the SCBA until you put on the facepiece.
  6. Put the fully encapsulated suit over the SCBA and shoulders.
  7. Put on outer boots (If needed).
  8. Make necessary connections inside the suit (ventilation system or air line).
  9. Don the facepiece.
  10. Perform a positive pressure (two-finger) check.
  11. Perform a negative pressure check (optional).
  12. Don the rest of the fully encapsulated suit.
  13. Put on outer gloves.

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**SECTION 4 - STANDARD OPERATING PROCEDURE 7**

- A. Refill a 2200 psi SCBA cylinder with a cascade charging system using the following steps:
1. Check all connections to make sure there are no leaks.
  2. Inspect the cylinder for signs of excessive wear or abuse and check the hydrostatic test date. Do not refill it if there is a doubt.
  3. Make sure the tanks are numbered properly (1, 2, 3, and 4 with 4 having the highest pressure).
  4. Attach the cascade system coupling to the cylinder. (The cylinder may be immersed in water. Follow the manufacturer's recommendations. Filling the tanks slowly will prevent overheating).
  5. Open the cylinder valve.
  6. Slowly open tank number 1 until the tank pressure and cylinder pressure equalizes (No rushing air can be heard).
  7. Close tank 1.
  8. If the cylinder pressure is not full, slowly open tank 2. (If the cylinder pressure reaches full, close tank 2 and go to step 21.) Listen until no air flow can be heard.
  9. Close tank 2.
  10. Slowly open tank 3. (Watch the cylinder gauge or pressure gauge.) If the pressure reaches full, close the tank and go to step 21. Listen until no air flow can be heard.
  11. Close tank 3.
  12. Slowly open tank 4. (Again, watch the cylinder gauge or pressure gauge. If the pressure reaches full, close the tank and go to step 21). Listen until no air flow can be heard.
  13. Close tank 4.
  14. If the cylinder pressure is still not full, you must replace tank 1 with a new tank. Make sure all fittings are tight.
  15. Number the new tank #4.
  16. Number tank 2 #1.
  17. Number tank 3 #2.
  18. Number tank 4 #3.
  19. Open tank #4 (new tank) until the cylinder pressure reads full.
  20. Close tank #4.
  21. Close the cylinder valve.
  22. Bleed the pressure from the lines with the bleed valve.
  23. If at any time the cylinder valve pressure and the pressure gauge on the cascade system do not equalize, remove all equipment from service and have repaired according to the manufacturers' recommendation.

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## APPENDIX 4-1 PROTECTION LEVELS AND EQUIPMENT

### **Level A protection should be used when:**

1. The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either:
  - Measured high concentrations of vapors, gases, or particulates.
  - Site operations and work functions involve a high risk of splash, immersion, or exposure to unexpected vapors, gases, or particulates.
2. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible.
3. Operations must be conducted in confined, poorly ventilated areas, and the absence of conditions requiring Level A have not yet been determined.

### **Level A equipment should consist of:**

- Positive pressure full face SCBA, combination SCBA, or positive pressure atmosphere supplying respirator with escape SCBA (NIOSH approved)
- Fully encapsulating, vapor and gas-proof, chemical protective suit
- Inner and outer chemical resistant gloves
- Chemical resistant safety boots or shoes
- Disposable protective suit, gloves, and boots. (May be worn over fully encapsulating suit depending on suit construction.)

### **Optional equipment may be:**

- Cooling units
- Coveralls
- Long underwear (cotton)
- Hard hat

This is the highest level of skin and respiratory protection; however, the materials of this ensemble must be compatible with the substances involved.

**Level B protection should be used when:**

1. The type and concentration of substances have been identified and require a high level of respiratory protection but less skin protection. This involves atmospheres that:
  - Have IDLH concentrations of specific substances that do not represent a severe skin hazard.
  - Do not meet the criteria for use of APRs.
2. Atmospheres containing less than 19.5% oxygen.
3. Presence of unidentified vapors or gases as indicated by direct reading instruments when these vapors are not suspected of containing high levels of chemicals harmful to the skin or able of being absorbed through the skin.

**Level B equipment should consist of:**

- Positive pressure full face SCBA, combination SCBA, or positive pressure air line respirator with escape SCBA (NIOSH approved)
- Hooded chemical resistant clothing (coveralls and long-sleeved jacket; coveralls; one- or two-piece chemical splash suit; disposable chemical resistant overalls)
- Inner and outer chemical resistant gloves
- Chemical resistant safety boots or shoes
- Hard hat

Optional equipment may be:

- Coveralls
- Face shield
- Long cotton underwear
- Disposable boot covers

Level B provides the same level of respiratory protection as Level A but with less skin protection. Level B is the minimum level recommended for initial site entry and should be used only when it is highly unlikely that the work being done will generate either high levels of vapors, gases, particulates, or splashes of chemicals or materials that will adversely effect the skin.

**Level C protection should be used when:**

1. The airborne contaminants, liquid splashes, or other direct contact will adversely affect or be absorbed through any exposed skin.
2. The types of air contaminants have been identified, measured, and an APR is available that can remove the contaminants.
3. All criteria for the use of APRs has been met.

**Level C equipment should include:**

- Full-face or half-mask APR (NIOSH approved)
- Hooded chemical resistant clothing (overalls, one or two piece chemical splash suit, disposable chemical resistant overalls)
- Inner and outer gloves
- Outer chemical resistant safety boots or shoes

Optional Level C equipment may be:

- Hard hat
- Coveralls
- Face shield
- Escape mask
- Disposable boot covers

The same level of skin protection is provided by Level C with a lower level of respiratory protection. Level C protection has the following limitations:

- Atmospheric concentrations must not exceed IDLH levels
- The atmosphere must contain at least 19.5% oxygen

**Level D protection can be used when:**

1. The atmosphere contains no known hazards.
2. Work functions do not include splashes, immersion, or the potential for unexpected inhalation of, or contact, with hazardous levels of any chemicals.

**Level D equipment should consist of:**

- Coveralls
- Outer chemical resistant safety boots or shoes
- Safety glasses or goggles

## Optional equipment may be:

- Gloves
- Escape mask
- Face shield
- Hard hat
- Disposable boot covers
- Safety glasses or chemical splash goggles

## Level D protective equipment should not be worn when:

- Respiratory protection or skin protection is required
- Inside of the exclusion zone
- The atmosphere contains less than 19.5% oxygen

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## APPENDIX 4-2 INSPECTION GUIDELINES

### Protective Suits

Before wearing chemical protective clothing in a hazardous atmosphere, it must be properly inspected. The following is a checklist for visually inspecting all types of chemical protective suits, both immediately before use and periodically when not in use:

1. Spread the suit out on a flat surface.
2. Examine the outside for the following:
  - Fabric and seams for abrasions, cuts, holes, or tears
  - Seams for separations
  - Zippers and other connecting devices for proper sealing and operation
  - Signs of previous chemical attack or incomplete decontamination
  - Exhaust valves (if applicable) for inhibiting debris and proper functioning

Fully-encapsulating vapor and gas suits need additional inspection on a regular basis. This inspection should include the following:

1. If an air source is available, seal the suit and inflate it. Check for any leaks on the surface and seams using a mild soap solution. Alternatively, the suit can be checked for small holes by placing a flashlight inside the suit in a dark room and looking for pinpoints of light from outside the suit.
2. Record each suit's use, inspection, and repair status. The manufacturer may recommend returning the suit to the factory on a yearly basis for a thorough inspection. On site re-use of a suit must be approved by a competent person assigned by the employer. Such authorization should be in the record kept for each suit.

### SCBA Inspection Checkout

Before an SCBA can be used, it must be properly inspected to help prevent malfunctions during use. The specific manufacturer's instructions for the devices you use should always be followed. However the following checklist is a general guideline for proper inspection of a positive pressure, pressure-demand SCBA.

*Prior to starting on checklist, make sure that the:*

1. High pressure hose connector is tight on cylinder fitting.
2. By-pass valve is closed.
3. Mainline valve is closed.
4. Regulator outlet is not covered or obstructed.
5. Cylinder valve is closed.

***Checklist for a positive pressure, pressure-demand SCBA:***

*Back pack and harness assembly:*

1. Visually inspect straps for complete set.
2. Visually inspect straps for frayed or damaged straps.
3. Visually inspect buckles for mating ends.
4. Physically check buckle locking function.
5. Visually inspect back plate for cracks and missing rivets or screws.
6. Visually inspect cylinder hold-down strap, physically check strap tightener and lock to assure that it is fully engaged.

*Cylinder and cylinder valve assembly:*

1. Physically check cylinder pressure. (Should be 2200 or 4500 psi.)
2. Physically check hydrostatic test date monthly to assure it is current.
3. Visually inspect for large dents or gouges in the metal monthly.
4. Physically check to ensure that it is tightly fastened to back plate.
5. If a fiberglass hoop wrapped cylinder (4500 psi) is used, make sure it has a retrofitted steel cylinder neck ring (Luxfur cylinders).

*Head and valve assembly:*

1. Visually determine if the cylinder valve lock is present monthly.
2. Visually inspect the cylinder gauge for condition of face, needle, and lens monthly.
3. Open cylinder valve and listen or feel for leakage around packing. (If leakage is noted, do not use until repaired.) Note the functioning of the valve lock.

*Regulator and high-pressure hose:*

1. Listen or feel for leakage in hose or at hose-to-cylinder connector. (Bubble in outer hose covering may be caused by seepage of air through hose when stored under pressure. This does not necessarily indicate a faulty hose.)

2. Check to ensure that the regulator outlet is not covered or obstructed. Open and close bypass valve momentarily to assure flow of air through the bypass system.
3. Cover regulator outlet with palm of hand or cap provided. Open mainline valve and read regulator gauge. (The gauge must read at least 1,800 or 4,000 psi and not more than rated cylinder pressure.) The alarm or bell should ring when the mainline valve is opened and the respirator is pressurized.
4. Close the cylinder valve and slowly bleed the emergency by-pass valve to allow air to flow slowly. Gauge should begin to show immediate loss of pressure as air flows. Low-pressure alarm should sound between 520 and 480 psi or 25% of remaining air (1125 psi in a 4500 psi cylinder). This alarm is the second alarm or bell.
5. Cover regulator outlet with palm of hand or cap provided. Open mainline valve and read regulator gauge. (The gauge must read at least 1,800 or 4,000 psi and not more than rated cylinder pressure.) The alarm or bell should ring when the mainline valve is opened and the respirator is pressurized. This is the third alarm or bell in a three-bell check.

*Facepiece and corrugated breathing tube:*

1. Visually inspect facepiece head harness for damaged serrations and deteriorated rubber. Visually inspect rubber facepiece body for signs of deterioration or extreme distortion.
2. Visually inspect the lens for proper seal in rubber facepiece, retaining clamp properly in place, and absence of cracks or large scratches.
3. Visually inspect exhalation valve for visible deterioration or buildup of foreign materials.
4. Carry out a negative pressure check for overall seal and check exhalation valve. During the monthly inspection, place mask against face and use following procedure; in preparing for use, don backpack, then facepiece, and use the following procedure: With facepiece held tightly to face (or facepiece properly donned), stretch breathing tube to open corrugations and place thumb or hand over end of connector. Inhale. Negative pressure should be created inside mask, causing it to pull tightly to face for 5-10 seconds. If negative pressure drops, this indicates a leak in the facepiece.

*Breathing tube and connector:*

1. Stretch the breathing tube and visually inspect for deterioration and holes.
2. Visually inspect connector to assure good condition of threads and for presence and proper condition of rubber gasket seals.

**Storage of the Positive Pressure, Pressure-Demand SCBA Units**

If the above mentioned inspection criteria is not met, then the SCBA unit should be set aside for repair by a certified technician.

- a. Cylinder refilled as necessary and unit cleaned and inspected.
- b. Cylinder valve closed.
- c. High-pressure-hose connector tight on cylinder.
- d. Pressure bled off of high-pressure hose and regulator.
- e. Bypass valve closed.
- f. Mainline valve closed.
- g. All straps completely loosened and laid straight.
- h. facepiece properly stored to protect against dust, direct sunlight, extreme temperatures, excessive moisture, and damaging chemicals, or stored in a carrying case available from the manufacturer.

### APPENDIX 4-3 RESPIRATOR INFORMATION

#### Protection Factors

Protection factor (PF) is a value assigned to a respirator based on its efficiency. If a respirator allows contaminants to leak around the face seal into the mask, it is less efficient.

The technical definition of PF is the concentration outside the respirator divided by the concentration that can get inside the respirator.

$$\text{PF} = \frac{\text{Concentration of contaminant outside the respirator}}{\text{Concentration inside the respirator}}$$

The practical definition of PF is how much of the outside contaminant level is reduced by the respirator.

- A respirator with a PF of 10 reduces exposure 10 times. The wearer is exposed to a concentration 1/10 of the outside concentration level.
- A respirator with a PF of 10,000 reduces exposure 10,000 times. The wearer is exposed to a concentration 1/10,000 of the outside concentration level.

A rule of thumb for protection factors is: Low PFs give the **LOWEST PROTECTION** and high PFs give the **HIGHEST PROTECTION**

#### Maximum Use Concentrations

Using the PF and the OSHA Permissible Exposure Limit (PEL), you can determine the highest level at which a respirator can be safely used. This level is called the maximum use concentration (MUC). The MUC is the PF multiplied by the PEL.

$$\text{MUC} = \text{PF} \times \text{PEL}$$

Example for nitric acid and half-face air purifying respirator (APR):

OSHA PEL for nitric acid	=	2	ppm
PF of half-face APR	=	10	
MUC	=	10 x 2	
	=	20	ppm

A half-face mask cannot be used in nitric acid levels exceeding 20 ppm. At no time should a respirator be used in an environment that exceeds the MUC.

### **Respirator Selection**

The industrial hygienist selects the correct respirator with the protection factor in mind. If airborne chemical levels are high, there is a chance that the respirator does not reduce exposure enough. If this happens, the worker may be overexposed even wearing a respirator.

### **Example**

Workers are using half-masks in an area where nitric acid levels are 50 ppm. Is this acceptable? No. The MUC for nitric acid and a half-face APR is 20 ppm.

### APPENDIX 4-4 RESPIRATOR PROFILES

Type of Respirator	Other Common Names	Protection Factor (NIOSH)	Limitations
<b>Disposable paper masks</b>	Single use masks	5	Limitations are severe. <b>Not</b> used for hazardous waste operations.
<b>Quarter masks</b>	Type B mask	5	Limitations are severe. <b>Not</b> used for hazardous waste operations.
<b>Half facepiece</b>	Cartridge mask, type A mask, negative pressure mask	10	Can only be used at low levels, where contaminants are known and adequate filters are available. Can not be worn in an oxygen-deficient atmosphere.
<b>Full facepiece</b>	Cartridge mask, canister mask, negative pressure mask.	50	Limited. protection. Can only be used when levels are fairly low and contaminants are known. Limited selection of filters. Can not be worn in an oxygen-deficient atmosphere.
<b>Powered air purifying</b>	PAPR	50	Protection depends on charged battery. Use is restricted by the same limitations as other full-face masks. Can not be worn in an oxygen-deficient atmosphere.
<b>Air line respirator</b>	Hose masks, ATMOSPHERE SUPPLYING RESPIRATOR masks, type C respirators	2,000 - full face pppd 10,000 - full face pppd w/ back-up air tank	Problems with hose limits and its usefulness.
<b>Self-contained breathing apparatus</b>	SCBA	50 - demand units 10,000 - pppd units	Very heavy. Limited air supply of 30, 45, or 60 minutes in 2,220 or 4,500 psi cylinders. Longer times with rebreathers - 1, 2, and 4 hours.





# HAZARDOUS WASTE WORKER

Section

**5**

Subject

**DECONTAMINATION**

## TRAINEE OBJECTIVES

After completing Section 5, you will be able to:

1. List six ways to avoid unnecessary exposure to contamination.
2. List two commonly used methods of decontamination.
3. List the activities that take place at each station in Level A condensed decontamination.
4. Explain the difference between full Level A decontamination and full Level B decontamination.
5. Explain the difference between full Level B decontamination and full Level C decontamination.

## Standard Operating Procedures

1. Perform Level A decontamination.
2. Perform Level B decontamination.
3. Perform Level C decontamination.
4. Perform equipment decontamination.



**INTRODUCTION**

On a hazardous waste site, workers wear personal protective equipment (*PPE*) to protect against chemicals and other safety hazards. But the nature of the work is such that the PPE itself will be exposed to and contaminated with chemicals. For example, walking through chemical puddles contaminates boots, and handling contaminated tools contaminates gloves. Spreading chemicals around defeats the purpose of safety precautions. Therefore, it's very important for a worker to know how to remove PPE without being exposed. A formal decontamination sequence must be followed. *Decontamination* is the process of removing or neutralizing chemicals that have accumulated on PPE, tools, or equipment used on the job.

**THE IMPORTANCE OF DECONTAMINATION**

It is important to understand how exposures would occur if decontamination was not done. Several important exposure pathways follow:

- Direct exposure of the worker. Without regular decontamination, chemicals could permeate the material of the suit or gloves. This permeation would lead to serious skin exposures.
- Exposure from protective equipment. There may be accidental chemical exposure while removing the suit and gloves. These exposures would accumulate day after day with the protective gear becoming a source of exposure.
- Exposure from tools. Accidental exposure could also occur from handling contaminated tools. A worker might not notice these exposures, as some chemicals can pass through the skin without any noticeable sensation. If tools aren't decontaminated, they could cause other workers to become exposed.

Family members can also be exposed to hazardous chemicals if workers go home with contaminated skin and street clothes. Therefore, decontamination requires much thought, planning, and effort. All workers should constantly be aware of their responsibility to protect themselves, their co-workers, and their families.

**CONTAMINATION**

Contamination occurs when a hazardous material is spread to an unwanted location. The following conditions are some sources of contamination:

- Leaks or breaks in containers or systems.
- Opening containers or systems without proper controls.
- Airborne contamination settling on surfaces.
- Poor housekeeping practices in contaminated areas.
- Excessive motion or movement in areas of high contamination.
- Sloppy work practices that result in cross-contamination of tools, equipment, or workers.

When working with hazardous materials, contamination can occur. However, using the work practices associated with contamination avoidance and contamination transfer can help workers reduce the spread of contamination.

**Contamination Avoidance**

Contamination avoidance is the process of preplanning in order to avoid unnecessary exposure.

To avoid unnecessary exposure to contamination, workers should:

- Use remote sampling and handling equipment. Equipment can be used to put distance between the worker and sources of obvious contamination. For example, when moving a drum, use a drum grapppler. The worker operating the grapppler gets less exposure than would occur from direct handling of the drum. Remote equipment also is available for sampling and opening drums.
- Avoid exposures through work practices. For example, a job can be arranged so that workers do not walk through areas of obvious contamination. Walk around these areas when possible.

- Use plastic bags and sheeting. Certain tools and instruments can be protected by keeping them in plastic bags. Openings in the bags are made where needed. Plastic sheets are also used to encase the source of contamination. A plastic sheet or liner is placed over a leaking barrel to cut down on contact with PPE.
- Wear PPE properly to receive maximum protection. Be sure that all openings in protective clothing are properly sealed. The potential for chemicals to enter any openings in the suit must be minimized. All zippers should be fully closed, and all buttons or snaps should be used. Gloves and boots should be tucked under sleeves and legs of suits. All seams should be sealed with tape.
- Wear a layer of disposable clothing (e.g., Tyvek<sup>®</sup>) on top of PPE. It protects the gear and minimizes the decontamination required.
- Maintain communication with a buddy or support staff.

To avoid unnecessary exposure to contamination, workers should **not**:

- Touch barrels, equipment, and debris unless the job requires them to.
- Sit on potentially contaminated soil, equipment, drums, etc.
- Be exposed to liquid or solid chemicals unless it's necessary to complete the work task.

### **Contamination Transfer**

Contamination transfer is the act of passing contamination from one item or person to another item or person. To help prevent contamination transfer, workers should:

- Doff the various levels of PPE with care.
- Remove clothing in the order established for the decontamination procedure. This process starts with removal of the garments most likely contaminated (outermost), such as outer gloves and boot covers, and works its way down to the least contaminated respirator facepiece. Once outer gloves are removed, avoid touching the outside of the splash suit or fully encapsulating suit. Always assume the inner gloves are contaminated and make every effort not to touch the skin.
- Assume equipment is still contaminated even though it has been washed. Many chemicals cannot be completely removed from chemical protective clothing.

Decontamination line workers should also assume their equipment is contaminated. They should never touch workers on their inner clothing or skin.

## **DECONTAMINATION PROCEDURE**

The Hazardous Waste Operations and Emergency Response regulations (29 CFR 1910.120) require procedures for all phases of decontamination, which must be implemented as follows:

- A decontamination procedure shall be developed, communicated to employees, and implemented before any employee or equipment may enter areas on site where the potential for exposure to hazardous substances exists.
- *Standard operating procedures (SOPs)* shall be developed to minimize employee contact with hazardous chemicals.
- All employees leaving contaminated areas shall be appropriately decontaminated.
- Decontamination procedures shall be monitored by the site safety and health officer.

It is a further requirement that the decontamination procedures for a site be detailed in the Site Safety and Health Plan.

**Decontamination Methods**

There are several different methods for removing contamination. The most commonly used methods are:

- Physical removal
- Chemical removal

**Physical Removal**

In some cases, contaminants can be easily dislodged. Scraping, brushing, and wiping are used to remove contaminants. Heat may be used to evaporate chemicals that have begun to permeate protective clothing. Several studies have shown that the simple process of airing out the suits for 8 to 24 hours can be very effective in removing some chemicals.

**Chemical Removal**

Sometimes physical removal is not enough and chemical rinses are needed. Certain solvents can act like a dry-cleaning fluid to remove a contaminant by chemical action. Sometimes strong detergents are used. Also, weak acid solutions can neutralize some caustic solutions and vice versa. Great care must be taken with chemical removal to be sure that the chemical used to aid decontamination doesn't damage the protective material, causing additional safety and health problems. There are three general methods for chemical decontamination of protective clothing:

- Water and detergent washing
- Water and bleach washing
- Dry cleaning – only effective if the dry cleaning solvent won't damage the protective clothing

During the decontamination process the use of water must be kept in mind. Once water is used to decon either personnel or equipment, it must be considered contaminated. This contaminated water must be collected and disposed of in a proper manner. The water collection system used for decon will vary with the size of the site and the anticipated length of time for the cleanup project. Sites with extended clean-up times usually build permanent and elaborate water collection systems. Sites with short clean-up times, use systems of

buckets and barrels to collect contaminated water. The site set up for decon will determine the amount of water used for the decontamination process.

**General Features and  
Location of a  
Decontamination Area**

The location of the decontamination area is critical to worker safety and is first established during site characterization. However, the location may change depending upon weather and/or work conditions.

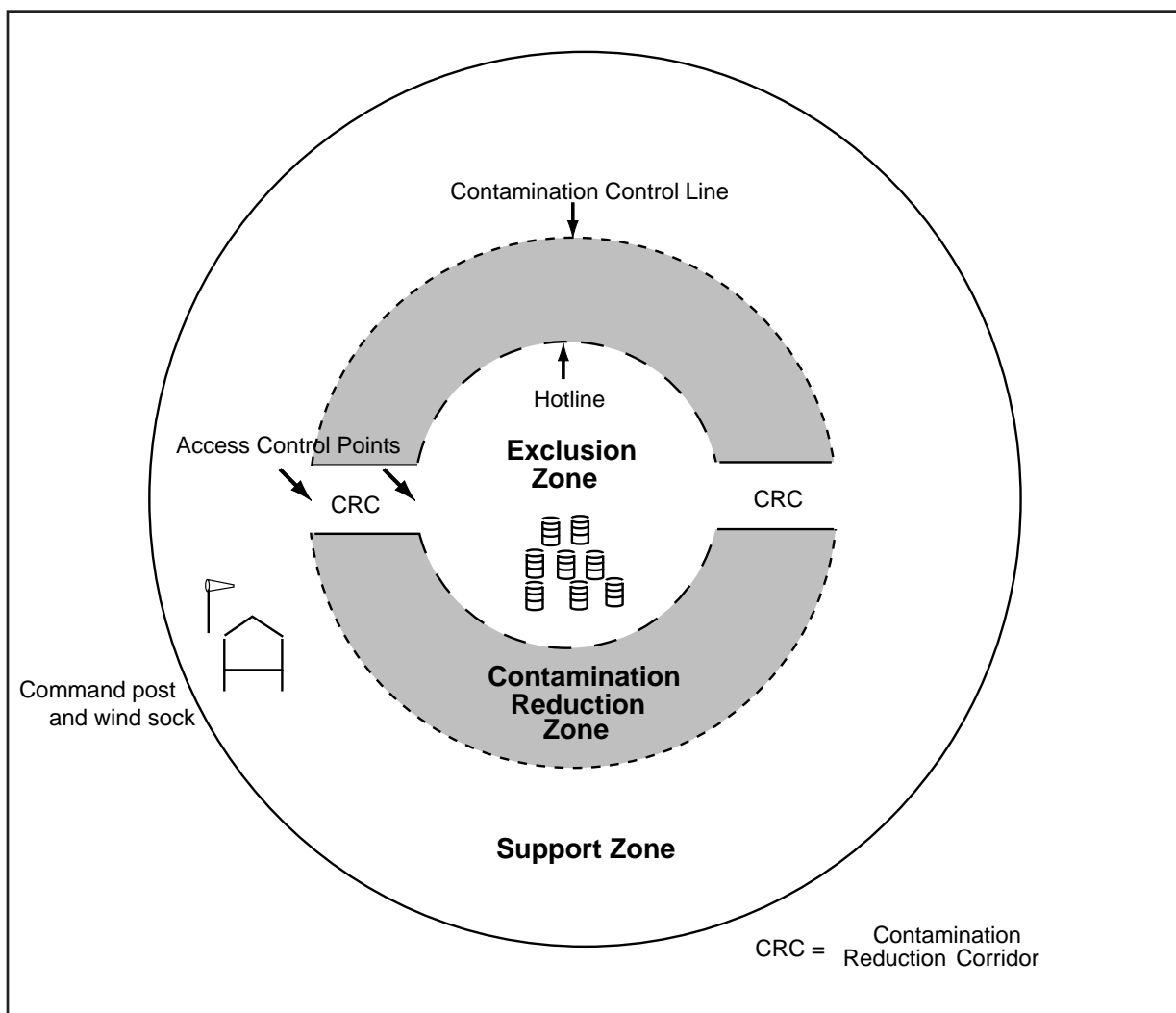
One end of the decontamination area must start in the exclusion zone. It extends over the hot line through the *contamination reduction zone (CRZ)*, with the clean end extending past the contamination control line into the support zone.

The decontamination area is often designated as the *contamination reduction corridor (CRC)* (Figure 5-1). The boundaries must be clearly marked, with entry and exit restricted. The exact sequence of decontamination to be followed depends on the level of PPE being used.

**FULL  
DECONTAMINATION  
PROCEDURES**

Full decontamination is the 19-station, 19-step procedure recommended by the Environmental Protection Agency (EPA). Although condensed decontamination procedures are commonly used on most clean-up sites, it is important to be familiar with full decontamination procedures in order to perform condensed decontamination. The difference between full and condensed decontamination is not the number of steps but the number of stations.

At waste sites, the decontamination procedure used will be established by the site safety and health officer, in accordance with the requirements of 29 CFR 1910.120. Normally these procedures will have fewer than 19 stations and place more responsibility on the individual for decontaminating his/herself.



**Figure 5-1.** Location of the contamination reduction corridor on a hazardous waste site.

### Level A-Full Decontamination Procedures

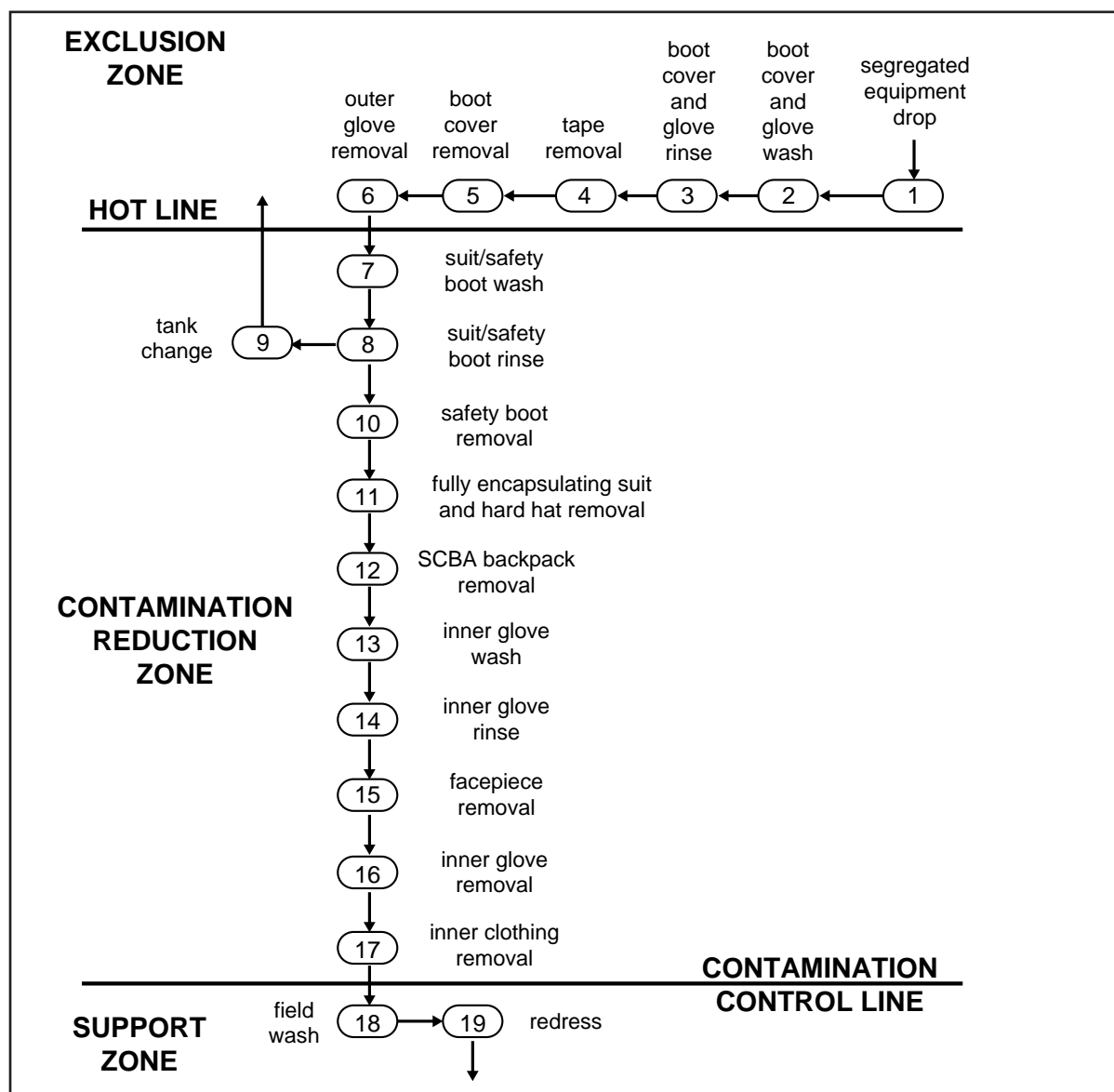
Level A decontamination procedures are used when workers are wearing fully encapsulating suits and SCBAs. Figure 5-2 shows the layout for Level A full decontamination procedures.

#### Exclusion Zone Stations

Decontamination stations 1 through 6 occur inside the exclusion zone.

#### Station 1— *Segregated Equipment Drop*

Deposit equipment on plastic drop cloths or in various containers lined with plastic. Equipment may include tools, sampling devices and containers, monitoring



**Figure 5-2.** Decontamination layout for level A protection.

instruments, radios, and clipboards. Because each piece of equipment will be contaminated to a different degree, it is important to separate types of equipment to avoid cross contamination. Equipment at this station includes:

- Containers of various sizes
- Plastic liners
- Plastic drop cloths.

*Station 2–  
Boot Cover and Glove  
Wash*

Scrub outer boot covers and gloves with a decon or detergent solution. Equipment at this station includes:

- 20–30 gallon (76–114 liter) container (a kiddie pool works well)
- Decon or detergent solution
- Long-handled scrub brushes

*Station 3–  
Boot Cover and Glove  
Rinse*

Rinse off the decon solution from station 2. Use a large amount of water as long as water usage doesn't pose a problem. Repeat as many times as necessary. If saving water is a priority, wipe the decon solution off with disposable towels. Equipment at station 3 includes:

- 20–30 gallon (76–114 liter) container (a kiddie pool works well)
- Water
- Long-handled scrub brushes
- Disposable towels

*Station 4–  
Tape Removal (if  
required)*

Remove the tape from around the boots and gloves and deposit it in a lined container. Equipment at this station includes a container with a plastic liner.

*Station 5–  
Boot Cover Removal*

Remove boot covers and deposit them in a lined container. Equipment at this station includes:

- Container with a plastic liner
- Bench or stool

*Station 6–  
Outer Glove Removal*

Remove outer gloves and deposit in a lined container. Equipment at this station includes a container with a plastic liner. If gloves are part of the level A suit, proceed to Station 7.

Contamination  
Reduction Zone

Decontamination stations 7 through 17 occur in the contamination reduction zone.

*Station 7–  
Suit and Safety Boot  
Wash*

Thoroughly wash the fully encapsulating suit and boots, starting at the top of the suit and working down to the boots. Be sure to scrub all areas, including the bottoms of the boots, with long-handled scrub brushes. Use large amounts of a decon solution or detergent and water, if allowed, and repeat as many times as necessary.

Equipment at this station includes:

- 30–50 gallon (114–190 liter) container (a kiddie pool works well)
- Decon solution or detergent and water
- Long-handled scrub brushes

*Station 8–  
Suit and Safety Boot  
Rinse*

Rinse off all decon or detergent and water solution with a large amount of water if possible. Repeat as many times as necessary. Equipment at this station includes:

- 30–50 gallon (114–190 liter) container (a kiddie pool works well)
- Water

*Station 9–  
Tank Change*

If the worker is leaving the work area to return to the support zone, this station is not required. If the worker is returning to the exclusion zone, this is the last step in the decontamination procedure. The worker's air cylinder is exchanged, new outer gloves and boot covers are donned and seams taped if necessary. The worker then returns to the work site. Equipment at this station includes:

- Air cylinders
- Boot covers
- Gloves
- Tape

*Station 10–  
Safety Boot Removal*

Remove safety boots and deposit them in a lined container. If the boots are fastened permanently to the suit, this station is not required. Equipment at this station includes:

- Container with a plastic liner
- Bench or stool
- Boot jack (optional)

*Station 11–  
Fully Encapsulating Suit*

With the assistance of a helper, remove the fully-encapsulating suit (and hard hat if used). If further decontamination is needed, take the suit to the proper area. If no further decon is needed, hang up the suit properly or lay it out on a drop cloth. Equipment at this station includes:

- Bench or stool
- Rack
- Drop cloth

*Station 12–  
SCBA Backpack  
Removal*

If possible, remove the self-contained breathing apparatus (SCBA) backpack and place it on a table. Disconnect the breathing hose from the regulator and proceed to the next station. If the hose cannot be disconnected, the backpack must be carried through the next two stations. Equipment at this station includes a table.

*Station 13–  
Inner Glove Wash*

Wash the inner gloves with a decon or detergent solution that will not harm the skin. Repeat as many times as necessary. Equipment at this station includes:

- Basin or bucket
- Decon or detergent solution
- Small table

*Station 14–  
Inner Glove Rinse*

Rinse the inner gloves with water and repeat as many times as necessary. Do not remove the gloves at this station. Equipment at this station includes:

- Water basin or bucket
- Small table

*Station 15–  
Facepiece Removal*

Remove the facepiece, or the SCBA if carried from station 12, and place it in a lined container or on a table for further decontamination and cleaning. Equipment at this station includes a small table or a container with a plastic liner.

*Station 16–  
Inner Glove Removal*

Remove the inner gloves, turning them inside out, and place them in a lined container. Equipment at this station includes a container with a plastic liner.

*Station 17–  
Inner Clothing Removal*

Remove the inner clothing and place in a lined container. Inner clothing should be removed as soon as possible since there is a possibility that small amounts of contaminants might have been transferred in removing the fully encapsulating suit. Equipment at this station includes:

- 30-50 gallon (114–190 liter) container
- Plastic liners

*Support Zone*

Decon stations 18 and 19 occur in the support zone.

*Station 18–  
Field Wash*

If toxic, skin-corrosive, or skin-absorbable materials are present or suspected to be present, a shower should be taken, and is recommended at all sites, especially after a potential exposure. If a shower is not available, wash hands, face, and arms. Equipment at this station includes:

- Shower
- Small table
- Basins
- Water
- Soap
- Towels

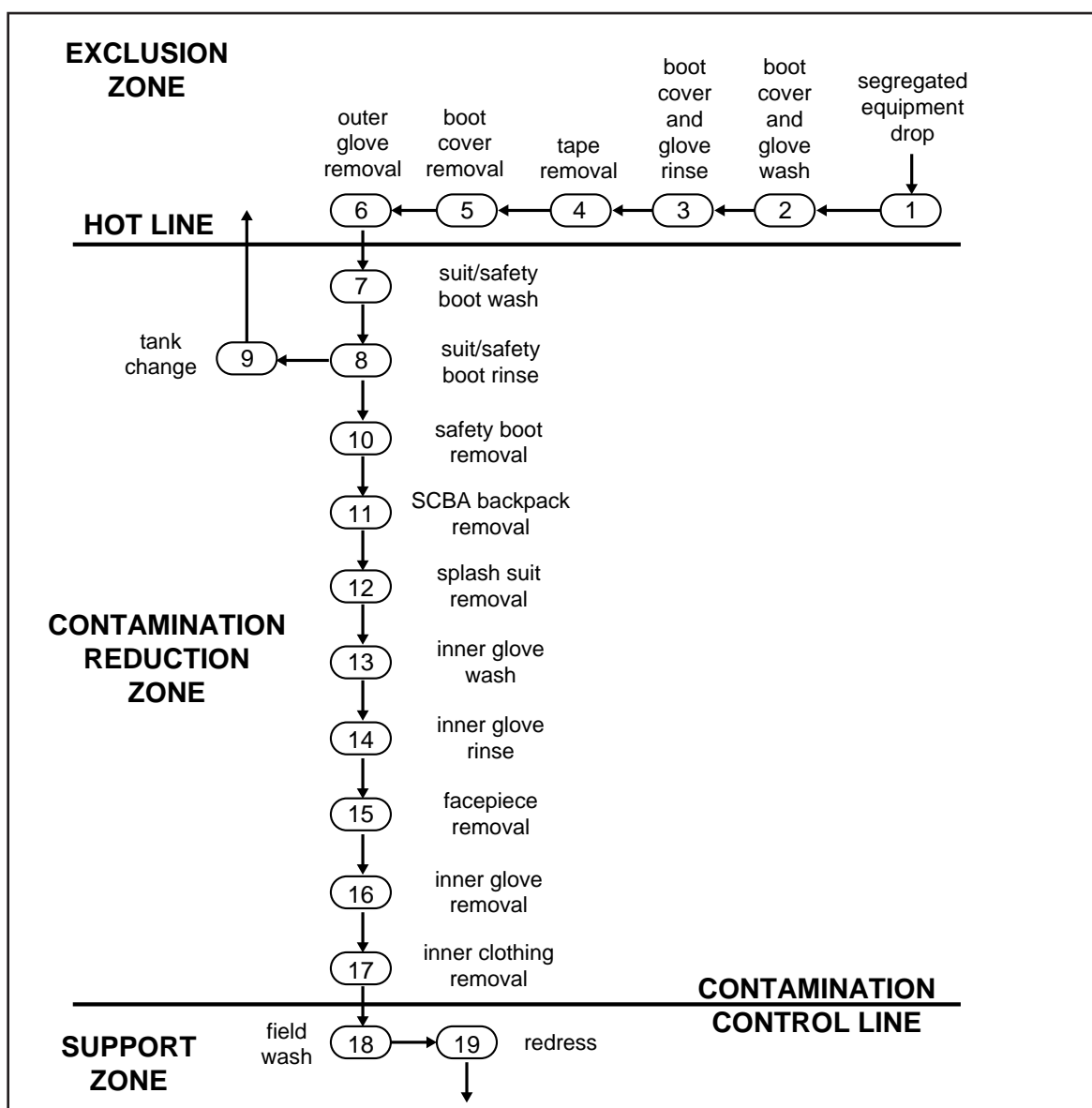
*Station 19–  
Redress*

Put on clean clothes. Equipment at this station includes:

- Dressing facility
- Tables
- Chairs
- Lockers
- Clean clothes

### Level B-Full Decontamination Procedures

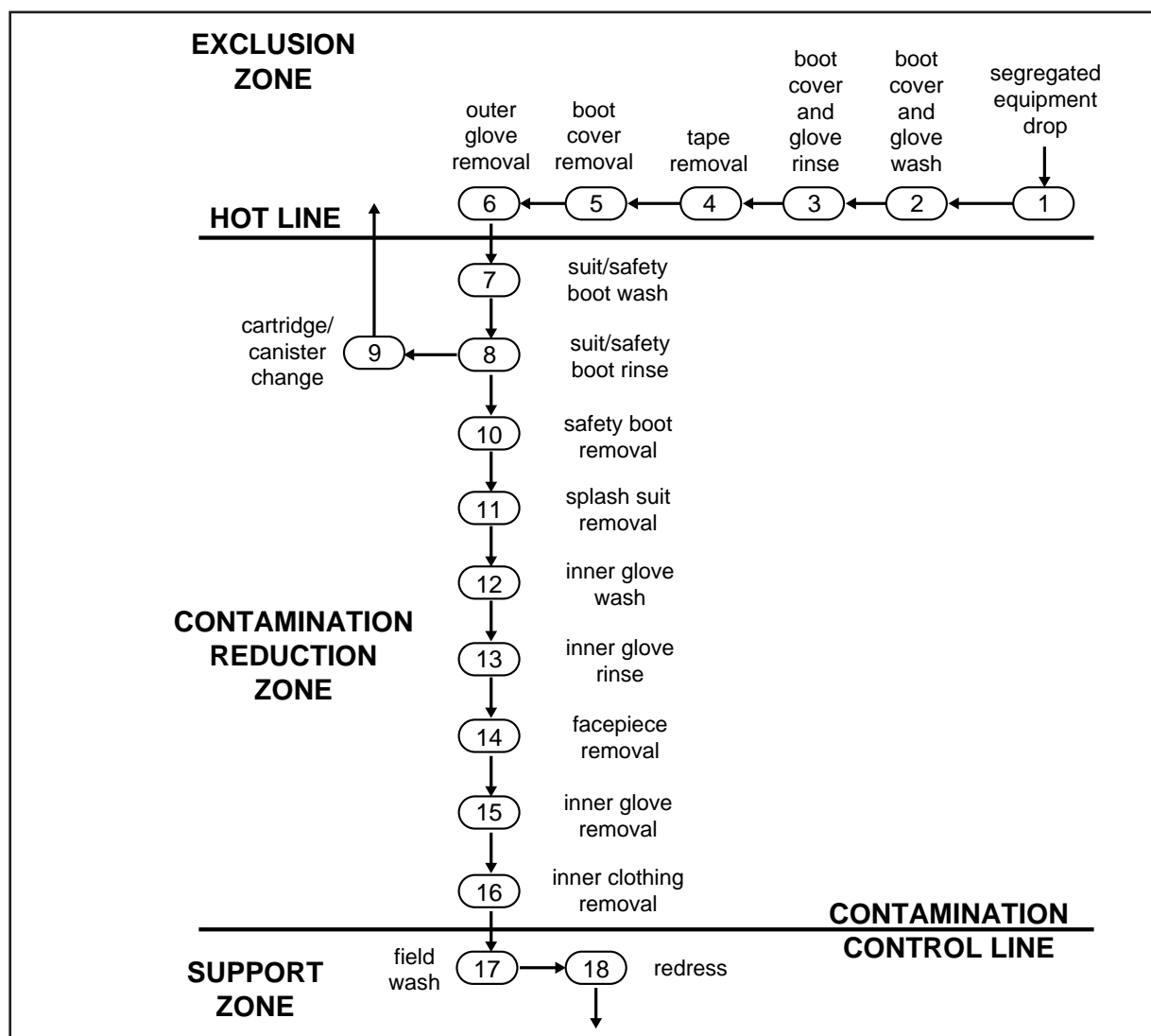
Level B full decontamination procedures are used when a worker wears a chemical protective splash suit and SCBA. Level B procedures are very similar to Level A full decontamination. The only difference in the procedure is the removal of the SCBA prior to the removal of the protective suit. (Stations 11 and 12 are reversed.) See Figure 5-3 for a graphic description of the full Level B decontamination process.



**Figure 5-3.** Decontamination layout for level B protection.

### Level C- Full Decontamination Procedures

Level C full decontamination procedures are used when a worker wears a splash suit and air purifying respirator. The process is similar to the level A and B procedures except for the obvious changes because of different respiratory protection. Station 9 switches from tank change to canister/filter or mask change and the SCBA backpack removal station is deleted. This changes the number of stations to 18. See Figure 5-4 for a graphic description of Level C decontamination procedures.



**Figure 5-4.** Decontamination layout for level C protection.

**CONDENSED  
DECONTAMINATION  
PROCEDURES**

Condensed decontamination procedures are commonly used at many clean-up sites. Like full decontamination procedures, there are 19 steps, but the steps are grouped into fewer stations. One major reason for the simplified procedure is that some protective clothing (coveralls, gloves, and boot covers) used at many current cleanups are removed and disposed as opposed to washed, rinsed, and removed.

**Level A-Condensed  
Decontamination  
Procedures**

The following text describes the condensed decontamination procedures for Level A protection. Figure 5-5 illustrates the steps.

*Station 1–  
Segregated Equipment  
Drop*

Deposit equipment on plastic drop cloths or in various containers lined with plastic. Equipment may include tools, sampling devices and containers, monitoring instruments, radios, and clipboards. Because each piece of equipment will be contaminated to a different degree, it is important to separate types of equipment to avoid cross contamination. Equipment at this station includes:

- Containers of various sizes
- Plastic liners
- Plastic drop cloths

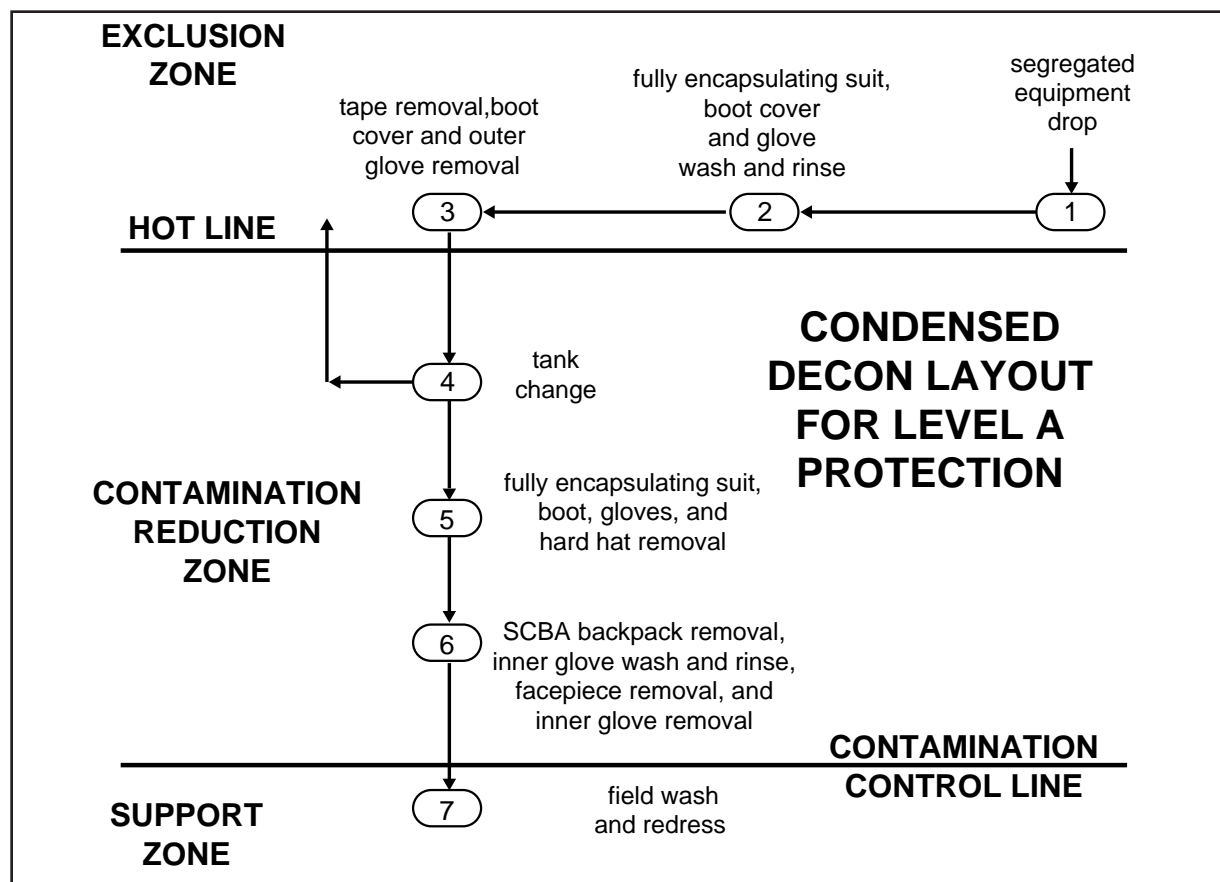
*Station 2–  
Suit, Boots, and Gloves  
Wash / Rinse*

Thoroughly wash the fully encapsulating suit, boots, and gloves, starting at the top of the suit and working down to the boots. Be sure to scrub all areas, including the bottom of the boots, with long-handled scrub brushes. Use large amounts of a decon or detergent solution and water to rinse, if allowed, and repeat as many times as necessary. Equipment at this station includes:

- 30-50 gallon (114–190 liter) container (a kiddie pool works well)
- Decon or detergent solution
- Water
- Long-handled scrub brushes

*Station 3–  
Boot Covers and Outer  
Gloves Removal*

Remove boot covers and outer gloves. Deposit them in a lined container. Equipment at this station includes a container with a plastic liner.



**Figure 5-5.** Condensed decon layout for level A protection.

*Station 4–  
Tank Change*

This station is not required if the worker is leaving the work area to return to the support zone. If the worker is returning to the exclusion zone, this station is the last step in the decontamination procedure. Exchange air cylinder, don new outer gloves and boot covers, and tape seams, if necessary. Return to work. Equipment at this station includes:

- Air cylinders
- Boot covers
- Gloves
- Tape

*Station 5–  
Fully Encapsulating  
Suit Removal*

With the assistance of a helper, remove the fully-encapsulating suit and hard hat. If further decontamination is needed, take the suit to the proper

area. If no further decon is needed, hang up the suit properly or lay it out on a drop cloth. Equipment at this station includes:

- Bench or stool
- Rack
- Drop cloth

*Station 6–  
SCBA Removal, Inner  
Glove Wash, Rinse,  
Removal and Field Wash*

Remove the backpack and SCBA and place it on a table. Do not touch your face with your hands. Wash the inner gloves with decon or detergent solution that won't harm the skin. Repeat as many times as necessary. Rinse the inner gloves with water and repeat as many times as necessary. Remove the facepiece. Remove the inner gloves. Equipment at this station includes a table.

*Station 7–  
Field Wash and Redress*

Take a shower if toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. Showers are recommended at all sites and after all potential exposures. If a shower is not available, wash hands, arms, and face. Equipment at this station includes:

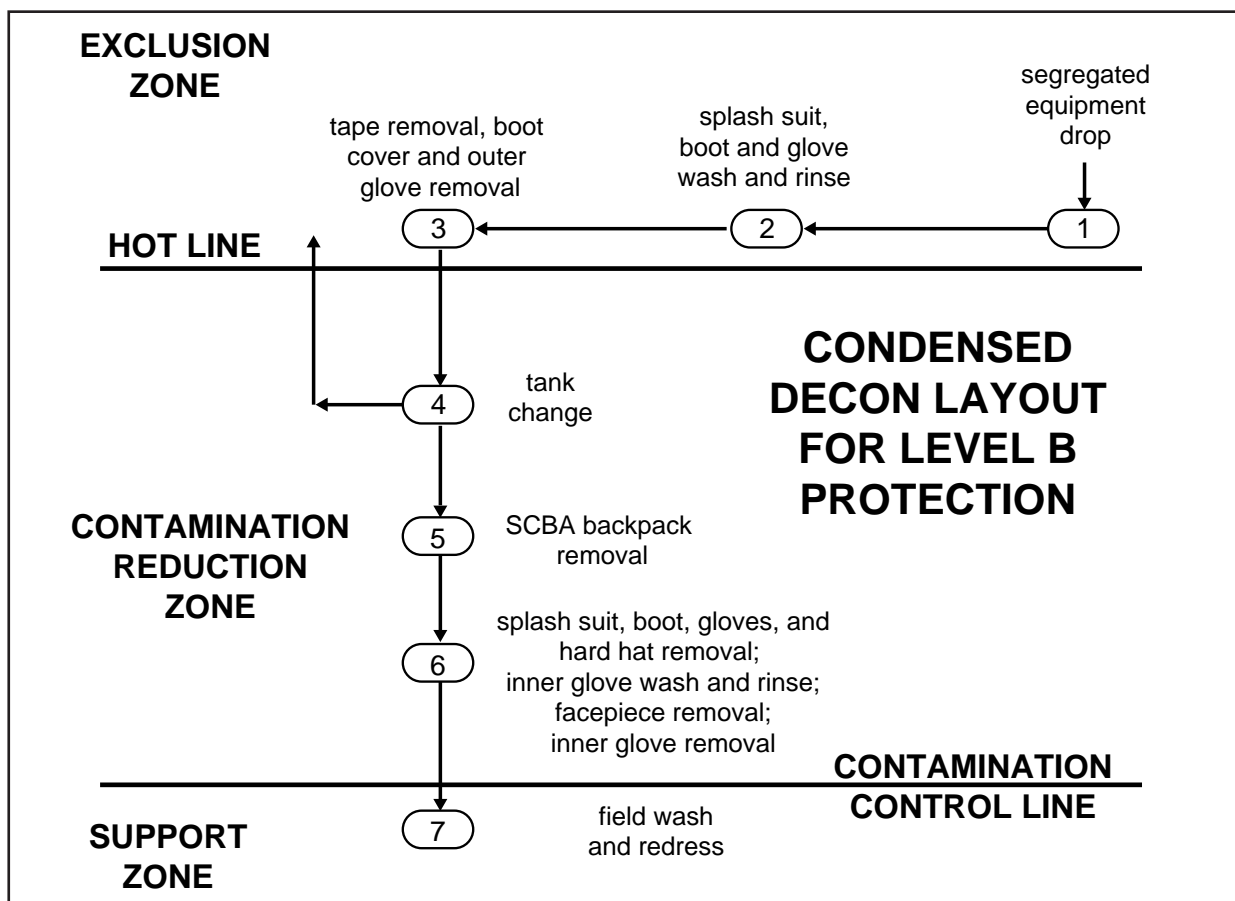
- Shower
- Small table
- Basins or buckets
- Water
- Soap
- Towels
- Decon or detergent solution
- Water basin or bucket

**Level B–Condensed  
Decontamination  
Procedures**

The following text describes the condensed decontamination procedures for Level B protection. Figure 5-6 illustrates the steps.

*Station 1–  
Segregated Equipment  
Drop*

Deposit equipment onto plastic drop cloths or in different containers lined with plastic. Equipment may include tools, sampling devices and containers, monitoring instruments, radios, and clipboards. Each piece of equipment will be contaminated to a different degree. Segregation at the drop reduces the chance of cross-contamination.



**Figure 5-6.** Condensed layout for level B protection.

Equipment at this station includes:

- Containers of various sizes with plastic liners
- Plastic drop cloths

*Station 2–  
Suit, Boots, and Gloves  
Wash/Rinse*

Thoroughly wash the chemical resistant splash suit, starting at the top of the suit and working down to the boots. Be sure to scrub all areas, including the bottom of the boots, with long-handled scrub brushes. Use large amounts of a decon or detergent solution and water to rinse, if allowed, and repeat as many times as necessary. Equipment at this station includes:

- 30-50 gallon (114–190 liter) container (a kiddie pool works well)
- Decon or detergent solution
- Water
- 2 or 3 long-handled scrub brushes

*Station 3–  
Tape Removal and Boot  
Covers and Outer Gloves  
Removal*

Remove the tape from around the boot covers and outer gloves and deposit in a lined container. Remove boot covers and outer gloves and deposit in a lined container. Equipment at this station includes two containers with plastic liners.

*Station 4–  
Tank Charge*

This station is not required if the worker is leaving the work area to return to the support zone. If the worker is returning to the exclusion zone, this is the last step in the decontamination procedure. The worker's air cylinder is exchanged, new outer gloves and boot covers are donned, and seams are taped if necessary. The worker then returns to work. Equipment at this station includes:

- Air cylinders
- Boot covers
- Gloves
- Tape

*Station 5–  
SCBA Removal*

Remove the backpack and SCBA and place it on a table. Workers should avoid touching their faces with their hands. Equipment at this station includes a table.

*Station 6–  
Suit Removal, Inner  
Glove Wash, Rinse,  
Removal*

With the assistance of a helper, remove the chemical resistant splash suit and hard hat. If further decontamination is needed, take the suit to the proper area. If no further decon is needed, hang up the suit properly or lay it out on a drop cloth. Deposit the gloves and boots in separate, lined containers. Wash the inner gloves with decon or detergent solution that won't harm the skin. Repeat as many times as necessary. Rinse the inner gloves with water and repeat as many times as necessary. Remove the facepiece. Remove the inner gloves. Equipment at this station includes:

- Bench or stool
- Rack
- Drop cloth
- Containers with lined plastic

*Station 7–  
Field Wash*

Take a shower if toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present. Showers are recommended at all sites and after all potential exposures. If a shower isn't available, wash hands, arms, and face. Equipment at this station includes:

- Shower
- Small table
- Basins or buckets
- Water
- Soap
- Towels
- Decon or detergent solution
- Water basin or bucket

**Level C–Condensed  
Decontamination  
Procedures**

The following text describes the condensed decontamination procedures for Level C protection. Figure 5-7 illustrates the steps.

*Station 1–  
Segregated Equipment  
Drop*

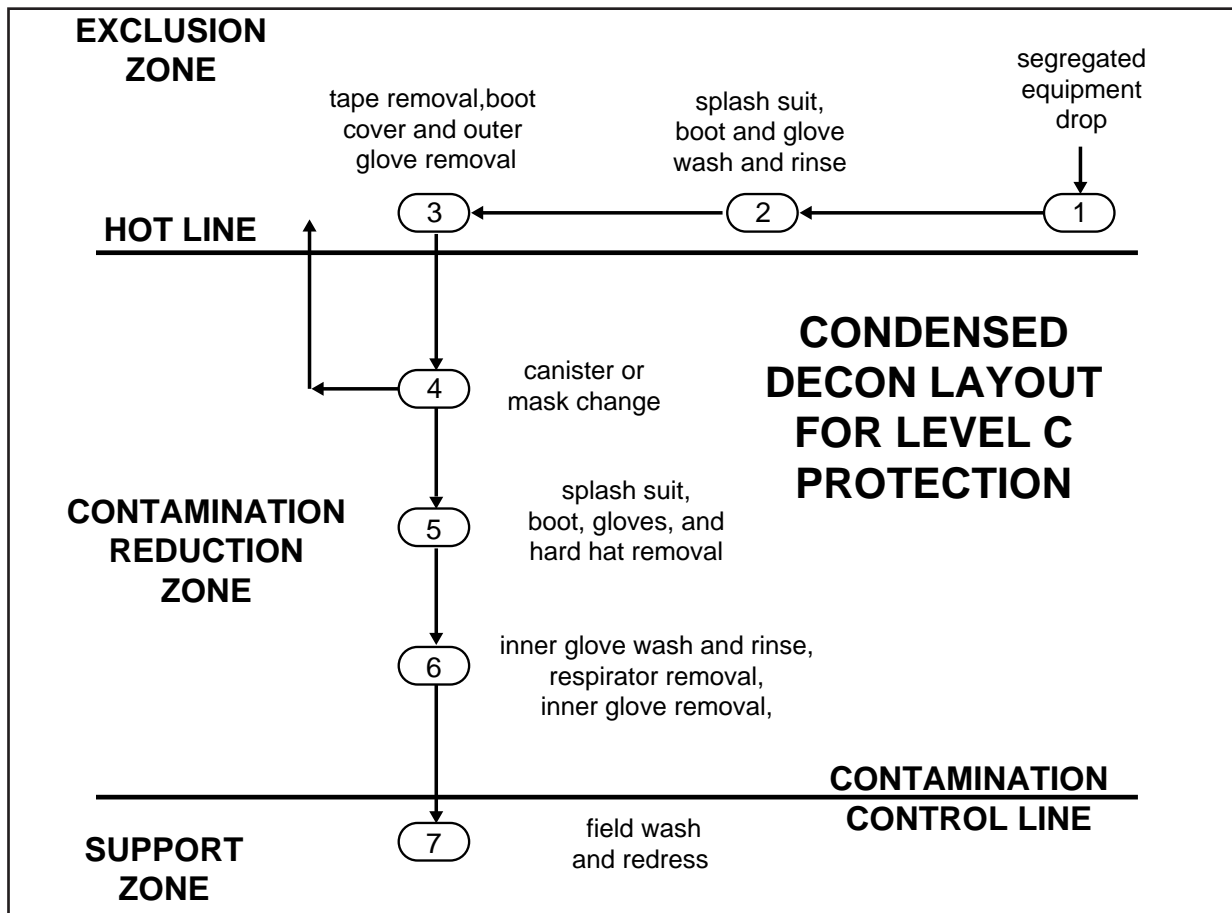
Deposit equipment used on-site on plastic drop cloths or in different containers lined with plastic. Equipment may include tools, sampling devices and containers, monitoring instruments, radios, and clipboards. Each piece of equipment will be contaminated to a different degree. Segregation at the drop reduces the chance of cross-contamination. Equipment at this station includes:

- Containers of various sizes with plastic liners
- Plastic drop cloths

*Station 2–  
Suit, Boots, and Gloves  
Wash/Rinse*

Thoroughly wash the chemical resistant splash suit, boots, and gloves starting at the top of the suit and working down to the boots. Be sure to scrub all areas, including the bottom of the boots, with long-handled scrub brushes. Use large amounts of decon or detergent solution and water to rinse, if allowed. Repeat as many times as necessary. Equipment at this station includes:

- 30-50 gallon (114–190 liter) container (a kiddie pool works well)
- Decon or detergent solution
- Water
- Long-handled scrub brushes



**Figure 5-7.** Condensed decon layout for level C protection.

*Station 3–  
Tape Removal and Outer  
Glove and Boot Removal*

Remove the tape from around the outer boots and gloves and deposit in a lined container. Remove outer boots and gloves and deposit in a lined container. Equipment at this station includes two containers with plastic liners.

*Station 4–  
Canister or Mask Change*

This station is not required if a worker is leaving the work area to return to the support zone. If the worker is returning to the exclusion zone, this step is the last one in the decontamination procedure. Exchange the mask or canisters, don new outer gloves and boot covers, and tape seams if necessary. Return to work. Equipment at this station includes:

- Canisters
- Masks
- Boot covers
- Gloves
- Tape

*Station 5–  
Boots, Gloves, and Suit  
Removal*

With the assistance of a helper, remove the chemical resistant splash suit, gloves, boots and hard hat if used. If further decontamination is needed, take the suit to the proper area. If no further decon is needed, hang up the suit properly or lay it out on a drop cloth. Deposit the gloves and boots in separate lined containers.

Equipment at this station includes:

- Bench or stool
- Rack
- Drop cloth
- Containers with plastic liners

*Station 6–  
Inner Glove Wash, Rinse,  
and Removal, Respirator  
Removal*

Wash the inner gloves with decon or detergent solution that won't harm the skin. Repeat as many times as necessary. Rinse the inner gloves with water and repeat as many times as necessary. Remove the respirator and place it on a table. Workers should avoid touching their faces with their hands. Remove the inner gloves.

Equipment at this station includes a table.

*Station 7–  
Field Wash*

Take a shower if toxic, skin-corrosive, or skin-absorbable materials are known or suspected to be present.

Showers are recommended at all sites and after all potential exposures. If a shower isn't available, wash hands, arms, and face. Equipment at this station includes:

- Shower
- Small table
- Basins or buckets
- Water
- Soap
- Towels
- Decon or detergent solution
- Water basin or bucket

**WORKING ON THE  
DECON LINE**

If workers assist with the decontamination procedures, they may be exposed. The site safety and health officer must decide the level of protection required for decon line workers. In some cases, the decon workers will need the same protection as workers in the exclusion zone. This is the case especially at the beginning of a job, where hazards are not well characterized, or where exclusion zone workers may be heavily contaminated.

The type of decontamination procedures used also are a factor in choosing protection. For example, steam jets may be used as a part of decon. They produce high moisture levels; therefore, the PPE being used by the worker must be able to withstand moisture. Solvents used for decontamination may damage certain types of PPE. The decon line workers at the “dirty” end will need more protection than workers at the “clean” end. It is typical for decon line workers to use Level B or Level C protection.

**DECONTAMINATION  
OR DISPOSAL OF  
EQUIPMENT**

All equipment must be decontaminated before leaving the site. Many wooden tools, leather harnesses, and other articles with porous surfaces may absorb chemicals to the point where decontamination is not realistically possible. For these types of articles, disposal is better than decontamination. Buckets, brushes, and other contaminated tools are usually put in containers and labeled for disposal. Also, wash water and spent solutions must be collected and disposed of properly. Large pieces of equipment, such as backhoes, bulking chambers, and trucks pose serious decontamination problems. High pressure steam lines are commonly used to decon these types of equipment. Sandblasting is sometimes required. Shovels, lifts, and scoops may have to be sandblasted.

Wipe tests are used to determine when decontamination has been achieved. In a wipe test, a piece of gauze or filter paper is drawn across a surface. The filter is then analyzed for chemical content. A wipe test gives data on how much chemical contamination is present on a surface.

**EMERGENCY  
DECONTAMINATION**

The decontamination procedures just described are for routine daily operation. However, it's important to have emergency decontamination procedures developed and for workers to be familiar with them. The emergency procedures must be carried out using established SOPs. However, if immediate medical treatment is required to save a life, decontamination can wait. Listed below are some possible emergency situations.

- Physical injury – For minor medical problems or injuries, the normal decontamination procedure should be followed; however, life-saving care should be started immediately without decontamination. Respirators and backpacks usually need to be removed. Sometimes protective clothing must be cut away.
- Heat stress – Heat stroke is the most serious heat-related illness. Treatment must be immediate because heat stroke can kill. Omit or reduce the decontamination procedures and begin treatment right away. For heat related disorders less severe than heat stroke, decontamination is usually done.
- Chemical exposure – When contamination is the cause of the emergency, decontamination is part of the medical response. For example, a chemical burn might be flooded with water. If medical problems are not severe, decontamination also should be done.

Because every emergency is different, individual judgement must be used in each situation. Teamwork, planning, and knowledge of first-aid are important components of a good emergency program.

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**SECTION 5 - ASSIGNMENT SHEET**

1. List six ways to avoid unnecessary exposure to contamination.

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2. List two commonly used methods of decontamination.

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3. List the activities that take place at each station in Level A condensed decontamination.

Station 1: 

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Station 2: 

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Station 3: 

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Station 4: 

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Station 5: 

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Station 6: 

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Station 7: 

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5. Explain the difference between full Level A decontamination and full Level B decontamination.

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6. Explain the difference between full Level B decontamination and full Level C decontamination.

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**SECTION 5-STANDARD OPERATING PROCEDURE 1****Level A  
Decontamination**

Decontaminate a fellow trainee (buddy) in Level A PPE using the following steps.

- Station 2: Scrub your buddy's gloves and outer boots with a brush and decon solution. Make sure to remove as much of the contaminants as possible, quickly and efficiently.
- Station 3: Rinse off the decon solution with water. If you are collecting the water for disposal, use only what is necessary, or wipe down the boots with disposable towels.
- Station 4: Remove the duct tape. Deposit tape and disposable towels in a plastic-lined container.
- Station 5: Help your buddy remove his/her boot covers. If the boots are disposable, turn them inside out as you are pulling them off. This reduces exposure. Deposit them in a plastic-lined container.
- Station 6: Remove your buddy's outer gloves, again turning them inside out if they are disposable. Deposit them in a plastic-lined container.
- Station 7: Scrub your buddy's fully encapsulating suit, gloves, and boots with a brush and decon solution. Start at the top and make sure you get all contaminants.
- Station 8: Rinse off all of the decon solution with water. If you are collecting the water for disposal, use only what is necessary or wipe down with disposable towels. Discard the towels in the proper container.
- Station 9: If your buddy is returning to the exclusion zone, help him/her exchange the SCBA cylinder. You will have to open the suit. Be careful to prevent contamination of the inside of the suit. Help your buddy don the suit and put on new outer gloves and boots. Tape seams with duct tape (if necessary).
- Station 10: If your buddy is done in the exclusion zone, help him/her remove his/her boots if they are not attached to the suit.

- Station 11: Help your buddy remove his/her fully encapsulating suit and hard hat. If the suit needs additional decontamination, take it to the proper decon area after your buddy has completed Station 17.
- Station 12: Help your buddy remove his/her SCBA. If it needs further decontamination, take it to the proper area after your buddy has completed Station 17.
- Station 13: Follow your buddy through stations 13, 14, 15, 16, and 17. Assist if necessary. Decontaminate the suit, SCBA, and other PPE if needed. Store them in the proper area.

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**SECTION 5-STANDARD OPERATING PROCEDURE 2****Level B  
Decontamination**

Decontaminate a fellow trainee (buddy) in Level B PPE using the following steps:

- Station 2: Scrub your buddy's gloves and outer boots with a brush and decon solution. Make sure to remove as much of the contaminants as possible, quickly and efficiently.
- Station 3: Rinse off the decon solution with water. If you are collecting the water for disposal use only what is necessary, or wipe down the boots with disposable towels.
- Station 4: Remove the duct tape. Deposit tape and disposable towels in a plastic-lined container.
- Station 5: Help your buddy remove his/her boot covers. If the boots are disposable, turn them inside out as you are pulling them off. This reduces exposure. Deposit them in a plastic lined container.
- Station 6: Remove your buddy's outer gloves, again turning them inside out if they are disposable. Deposit them in a lined container.
- Station 7: Starting at the top, scrub your buddy's splash suit, SCBA, gloves, and safety boots with a brush and decon solution. Make sure you get all contaminants.
- Station 8: Rinse off all of the decon solution with water. If you are collecting the water for disposal, use only what is necessary, or wipe down with disposable towels. Discard the towels in the proper container.
- Station 9: If your buddy is returning to the exclusion zone, help him/her exchange the SCBA cylinder and put on new outer gloves and boots. Tape seams with duct tape (if necessary).
- Station 10: If your buddy is done in the exclusion zone, help him/her remove his/her safety boots and deposit in a plastic-lined container.
- Station 11: Help your buddy remove his/her SCBA.

- Station 12: Help your buddy remove his/her splash suit. If it is disposable, deposit it in the proper container. If the suit, SCBA, or other PPE need further decontamination, take it to the appropriate decon area after your buddy has completed Station 17.
- Station 13: Follow your buddy through stations 13, 14, 15, 16, and 17. Assist if necessary. Decontaminate the suit, SCBA, and other PPE, if needed. Store them in the proper area.

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**SECTION 5-STANDARD OPERATING PROCEDURE 3****Level C  
Decontamination**

Decontaminate a fellow trainee (buddy) in Level C PPE using the following steps.

- Station 2: Scrub your buddy's gloves and outer boots with a brush and decon solution. Make sure to remove as much of the contaminants as possible, quickly and efficiently.
- Station 3: Rinse off the decon solution with water. If you are collecting the water for disposal, use only what is necessary, or wipe down the boots with disposable towels.
- Station 4: Remove the duct tape. Deposit tape and disposable towels in a plastic-lined container.
- Station 5: Help your buddy remove his boot covers. If the boots are disposable, turn them inside out as you are pulling them off. This reduces exposure. Deposit them in plastic-lined containers.
- Station 6: Remove your buddy's outer gloves, turning them inside out if they are disposable. Deposit them in a plastic-lined container.
- Station 7: Starting at the top, scrub your buddy's splash suit, gloves, and safety boots with decon solution. Make sure you get all the contaminants.
- Station 8: Rinse off all decon solution using water. If you are collecting the water for disposal, use only what is necessary, or wipe down with disposable towels. Discard the towels in the appropriate containers.
- Station 9: If your buddy is returning to the exclusion zone, help him/her exchange filters or cartridges and new outer gloves and boots. Tape seams with duct tape if necessary.
- Station 10: If your buddy is done in the exclusion zone, help him/her remove his/her safety boots and deposit them in a lined container.

- Station 11: Help your buddy remove his/her splash suit. If it is disposable, deposit it in the proper container. If it needs further decontamination, take it to the appropriate decon area after your buddy has completed Station 16.
- Station 12: Follow your buddy through stations 12, 13, 14, 15, and 16. Assist if necessary. Decontaminate the suit and other PPE if needed. Store them in the proper area.

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**SECTION 5-STANDARD OPERATING PROCEDURE 4****Equipment  
Decontamination**

Decontaminate equipment used on the simulated waste site.

In general, the procedures used for decontaminating equipment are the same as the procedures used for decontaminating workers. Usually only two steps are used.

1. Wash all equipment with decon solution and brushes. Large equipment can be steam-cleaned or pressure-washed. Start at the top and work your way to the bottom. Be complete.
2. Rinse all equipment with water. If the water is being collected for disposal, use as little as possible. Use disposable towels and wipe the equipment. Put the towels in the proper container.

There may be special circumstances or procedures that differ. If equipment (i.e. monitoring equipment) can be damaged with water, then alternate methods of decontamination must be used. Follow the instructions and procedures listed in the site safety and health plan.





# HAZARDOUS WASTE WORKER

Section

**6**

Title

**SITE SAFETY AND  
HEALTH PLAN**

## TRAINEE OBJECTIVES

After completing Section 6, you will be able to:

1. List the ten minimum requirements for a site safety and health plan.
2. List four examples of unusual hazards that would make it necessary for additional special training.
3. Identify the following acronyms:  
  
CRZ  
CRC  
S&HO
4. List the two basic types of emergencies on a hazardous waste site and give four examples of each.
5. List five important elements of an emergency response plan.



## INTRODUCTION

The Occupational Safety and Health Administration (*OSHA*) regulations require the development of a written *site safety and health plan* for each hazardous waste site clean-up operation. The plan establishes the policies and procedures necessary to protect workers and the public from possible hazards at the site. The employer must develop the plan before any work begins and must go over the plan with every worker before anyone enters the site to begin work. The plan must be revised and updated whenever new information becomes available. For this reason, the plan is known as a living document. The plan must be kept on site and accessible to all workers and their Union representatives.

By law, the Site Safety and Health Program is required to designate one person at the site as the safety and health officer (*S&HO*). Although the S&HO also may have other duties, safety and health at the site are his/her primary concern. The S&HO has the following responsibilities:

- Ensure that the site safety and health plan is put into action and followed. Ensure everything is being done as the plan specifies.
- Answer workers' questions regarding health or safety problems.

Most of the cleanups that laborers will be involved in are known as *remedial actions* and are nonemergency situations. Remedial actions have the following characteristics:

- They normally last a long time (months to years).
- They begin after the more immediate (emergency) problems have been controlled.
- The work involves getting rid of the hazardous materials and restoring the site to a normal condition.

Remedial actions involve a variety of activities. Therefore, workers with different skills and crafts are needed, as well as support facilities, crews, and equipment.

There is plenty of time before the clean-up work starts to develop a thorough site safety and health plan. In fact, the site safety and health plan is developed at the same time as the site's *work plan*. (The work plan explains the actual clean-up process.) Usually by the time the actual cleanup begins, the site has been thoroughly investigated and studied. Also, the hazardous materials on the site have been located, identified, and assessed for risks.

Even though a lot is known about the hazards on a site, the site safety and health plan must provide for unexpected site emergencies which may occur as the work is being done. Being prepared for emergencies and having plans is the best way to reduce or eliminate possible injuries.

A great deal of background information is collected and used to develop the site safety and health plan. This information includes:

- Hazards at the site (chemicals, explosives, radioactive materials, etc.).
- Surrounding populations and use of land
- Normal weather conditions
- Type of ground (topography) and soil
- Groundwater destination and flow (i.e., stream or river)

## CONTENT

Site safety and health plans are specific to each hazardous waste site. Each plan will be different, although all plans may contain similar types of information. Regulations require that a site safety and health plan must contain, as a minimum, the following information:

- Safety and health risk or hazard analysis for each site task described in the work plan. Information on all known or suspected hazards shall be included.
- Level of worker training required, including any special training that is needed.

- Level of personal protective equipment (PPE) to be worn during the various site operations.
- Site-specific medical monitoring requirements. OSHA regulations describe the minimum medical monitoring required. Employers may adopt stricter requirements, but not more lenient ones.
- Description of the program for periodic air monitoring, personnel monitoring, and environmental sampling. This program should cover the types and frequency of monitoring, the monitoring instruments used, calibration methods, and equipment maintenance.
- Site control measures, including site work zones, the buddy system, site communication, and a site map.
- Decontamination procedures for workers and equipment.
- Emergency response plan that includes instructions on responding to site emergencies, handling injuries, notifying appropriate response organizations, and protecting personnel.
- Steps and precautions to be taken before any confined space can be entered.
- Procedures to be followed for containing and isolating spills.

## **SAFETY AND HEALTH RISK ANALYSIS**

Once the presence of a chemical has been established, then the physical and chemical properties can be identified using standard reference sources. These sources also provide data on the specific health hazards associated with the chemical, the permissible exposure limits (*PELs*), and other important data. Examples of these reference sources are:

- *Pocket Guide to Chemical Hazards* published by the National Institute of Occupational Safety and Health (*NIOSH*).

- Threshold limit values (*TLVs*) published by the American Conference of Governmental Industrial Hygienists (*ACGIH*).
- Material safety data sheets (*MSDSs*).

The site safety and health plan explains the site specific hazards and how they may affect a worker who's exposed to them. For example, during an initial site characterization, benzene is found on a hazardous waste site. The site safety and health plan would include the following information on benzene:

- Prolonged inhalation of benzene may result in acute effects, such as respiratory system irritation, headaches, and nausea.
- Chronic effects from inhaling benzene include damage to various organs and tissues, as well as cancer.

*MSDSs* and hazardous substance information forms (*HSIFs*) provide information on the chemical, physical, and toxic properties of each chemical known or suspected to be present on a hazardous waste site. In addition, any unique or unusual physical hazards present on the site are identified. Physical hazards include confined spaces, excavations, unstable ground, and bodies of water.

The last part of the risk analysis is a list of site activities to be completed during the clean-up operation. Using the activity list and the list of chemical and physical hazards, the safety and health personnel:

- Classify each activity (job) according to the level of hazardous material exposure:
  - No waste contact activities
  - Limited waste contact activities
  - Direct waste contact activities
- Develop a list of hazards associated with each activity.

On a large site, such as a landfill, where the presence of contaminants has been established, the level of PPE worn will vary depending on the location of the activity and the task itself. For example, if workers are erecting

a fence around the perimeter, a distance away from the contaminants in the landfill, they could be in level C or D PPE. However, if workers are drilling or excavating into the landfill, where exposure to contaminants could be high, the level of protection could be level B. These different work areas are established and marked as subareas in the exclusion zone.

## WORKER TRAINING REQUIREMENTS

OSHA Regulations 29 CFR 1910.120 require that all personnel working with hazardous waste receive a **minimum** of 40 hours of training. Training helps workers recognize and understand the health and safety hazards found on hazardous waste sites. They also learn how to protect themselves and their fellow workers against these hazards.

There are many hazardous waste sites located throughout the United States that must be cleaned up. Generally, hazardous waste sites differ in the following ways:

- Materials (chemicals, etc.) found and degree of hazards.
- Situations - types of containers, how they are stored, layout of the site, physical makeup of the site.
- Soil, ground, and weather.
- Site-specific hazards and problems.

In addition, OSHA requires that workers receive a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor when they begin a job. Because hazardous waste sites vary, this field experience prepares workers to work safely with the specific hazards at the site. At most sites, workers first receive a copy of the site-specific safety and health manual. The S&HO reviews it with them and discusses the most significant hazards. If the site has unusual hazards which the regular training (such as this course) did not cover, then workers receive site-specific

training and actual field experience to familiarize them with the work. A few examples of unfamiliar, unusual, or different hazards that may be found at a site are:

- An especially dangerous toxic chemical
- A possible explosive or radioactive danger
- Unusual containers
- Unstable ground or unusual terrain
- Unfamiliar type of clean-up work

### **PERSONAL PROTECTIVE EQUIPMENT**

Although this course trains workers to recognize and use PPE, not all PPE is the same. There are many manufacturers who make and supply PPE. Because of this, differences among the respirators and protective clothing available exist. In particular, different brands of self-contained breathing apparatus (SCBA) respirators have widely different methods of operation.

At any hazardous waste site, the site safety and health plan identifies, very specifically, the type of PPE that is supplied. Workers are required to pass a fit test using the type of respirator the site supplies. If special clothing is needed because of certain unique hazards, workers will be notified. The S&HO trains workers unfamiliar with the operation of the site's SCBA. Such training is part of the three day, site-specific training.

### **SPECIFIC MEDICAL MONITORING**

The safety and health plan at every site identifies the standard medical monitoring program for that site. Medical monitoring requirements vary from site to site, depending on the conditions of the site. They may also vary from worker to worker, depending on the tasks each worker is doing. For example, if a worker is constantly exposed to noisy equipment, hearing monitoring might be necessary. If any special medical monitoring requirements are needed, they must also be listed in the plan.

It is often impossible to identify every toxic substance (and its health effects) at a waste site. However, some types of substances or chemicals are more common than others on a hazardous waste site. As a result, their health effects are known. Medical monitoring is often carried out to follow the effect of these substances and chemicals on workers' health.

If previous site investigations revealed the presence of chemicals that attack specific organs, then regular tests might be required to track exposure to those chemicals. For instance, with the presence of lead dust, *urinalysis* is used to track lead exposure.

## **AIR MONITORING REQUIREMENTS**

The potential for worker exposure to dangerous concentrations of hazardous substances always exists on a hazardous waste site. Site conditions change as the work progresses, as the weather changes, and as different types of work are undertaken. Air monitoring is widely used to identify the concentration levels of chemicals in the air. The site safety and health plan must include an air monitoring plan that incorporates the following items, where appropriate:

- Types of chemicals to be monitored and frequency of monitoring.
- Activities requiring additional monitoring.
- Action levels (levels that if exceeded require immediate response such as evacuation, termination of activity, etc.)
- Types of monitoring instruments to be used, including calibration methods and maintenance.

## **SPILL CONTAINMENT**

Hazardous material spills are always a possibility on a hazardous waste site. Spilled material or waste can rapidly become even more hazardous and a greater number of workers run the risk of exposure. Therefore spills must be controlled, contained, and cleaned up.

To prevent this hazard and exposure, the site safety and health plan must outline the appropriate steps for:

- Reducing the likelihood of a spill occurring
- Containing spilled material and handling it rapidly
- Alerting personnel if an emergency situation develops
- Notifying appropriate agencies/authorities

Methods used to reduce the chance of spills are usually spelled out in the spill containment plan and might include:

- Procedures for handling containers.
- Provision of appropriate equipment, such as drum handling equipment and pumps.
- Use of carrier boxes, bins, etc.
- Provisions for containment of spilled material, such as:
  - Berms and dikes
  - Overpacks
  - Diversion and collection trenches or ditches.
  - Pans under equipment, lining equipment with plastic
  - Materials, such as sand, plastic, and absorbents (loose or as booms and pillows)
  - Vapor suppression and solidification agents/foams.

Once a spill develops, the emergency plan must identify who decides the magnitude of the problem and the appropriate response procedures. A hazardous material spill constitutes an unauthorized discharge of pollutants. Local, state, and federal laws may require that certain agencies be immediately notified, such as:

- Environmental Protection Agency (*EPA*)
- State Environmental Control Department
- Coast Guard
- Water Resource Commission
- Local fire and police departments

**DECONTAMINATION PROCEDURES**

In the early 1980s when the EPA began investigating some of the most hazardous waste sites, it developed the decontamination sequences that are explained in Section 5 of this course. The EPA procedures are structured and detailed. They are designed for seriously contaminated sites and/or those sites where the types of contamination are unknown. The regulations do not prescribe any specific decontamination procedure. They only require that:

- A decontamination procedure shall be developed, communicated to all employees, and implemented before any personnel or equipment may enter an area having the potential for exposure to hazardous substances.
- All employees leaving a contaminated area shall be appropriately decontaminated.
- Decontamination procedures shall be monitored by the S&HO to determine their effectiveness.

At most sites where a final cleanup is being undertaken, the hazards have already been defined and the methods developed to limit the workers' exposures during the clean-up process. For these reasons, the decontamination procedures will probably be much simpler and less involved. There will be fewer steps (many will be combined), and workers will be expected to do much of the decontamination themselves.

The site safety and health plan describes the decontamination procedure for a specific site and how it is to be implemented. It also gives information on:

- Disposal of contaminated clothing
- Disposal of decontamination water
- Requirements for showering
- Cleaning contaminated clothing

**SITE CONTROL**

Regulations require that each hazardous waste site have a site control program that typically includes the following elements:

- Site map
- Site work zones
- Buddy system
- Site security
- Site communications
- Standard operating procedures (*SOPs*)

Site control reduces worker contamination and contamination transfer by workers or equipment leaving the site. It does this in the following ways:

- Sets up security and physical barriers to exclude unnecessary personnel from the general area.
- Minimizes the number of workers and equipment by using only the number of workers needed for a job.
- Establishes work zones on-site.
- Establishes control points to regulate access to work zones.
- Conducts operations in a manner that reduces personnel and equipment exposure and eliminates the potential for airborne movement.
- Uses appropriate decontamination procedures.

**Site Map**

A site map showing topographic features, prevailing wind direction, drainage and the location of buildings, containers, impoundments, pits, ponds, streams, etc. helps in carrying out the following:

- Planning
- Assigning personnel
- Identifying access and evacuation routes and problem areas
- Identifying site areas that require the use of PPE

The map should be prepared before site entry and should be updated to represent current conditions.

**Work Zones**

When working with hazardous substances, there's always the potential for contamination and contamination transfer. Site personnel and equipment can become contaminated and carry the contamination into clean areas. Hazardous material can become airborne if it vaporizes, or the disturbance of contaminated soil may cause it to become windblown. To minimize the movement of hazardous substances from the site, contamination control procedures are needed. Two general methods are used:

1. Establishing site work zones
2. Decontaminating personnel and equipment

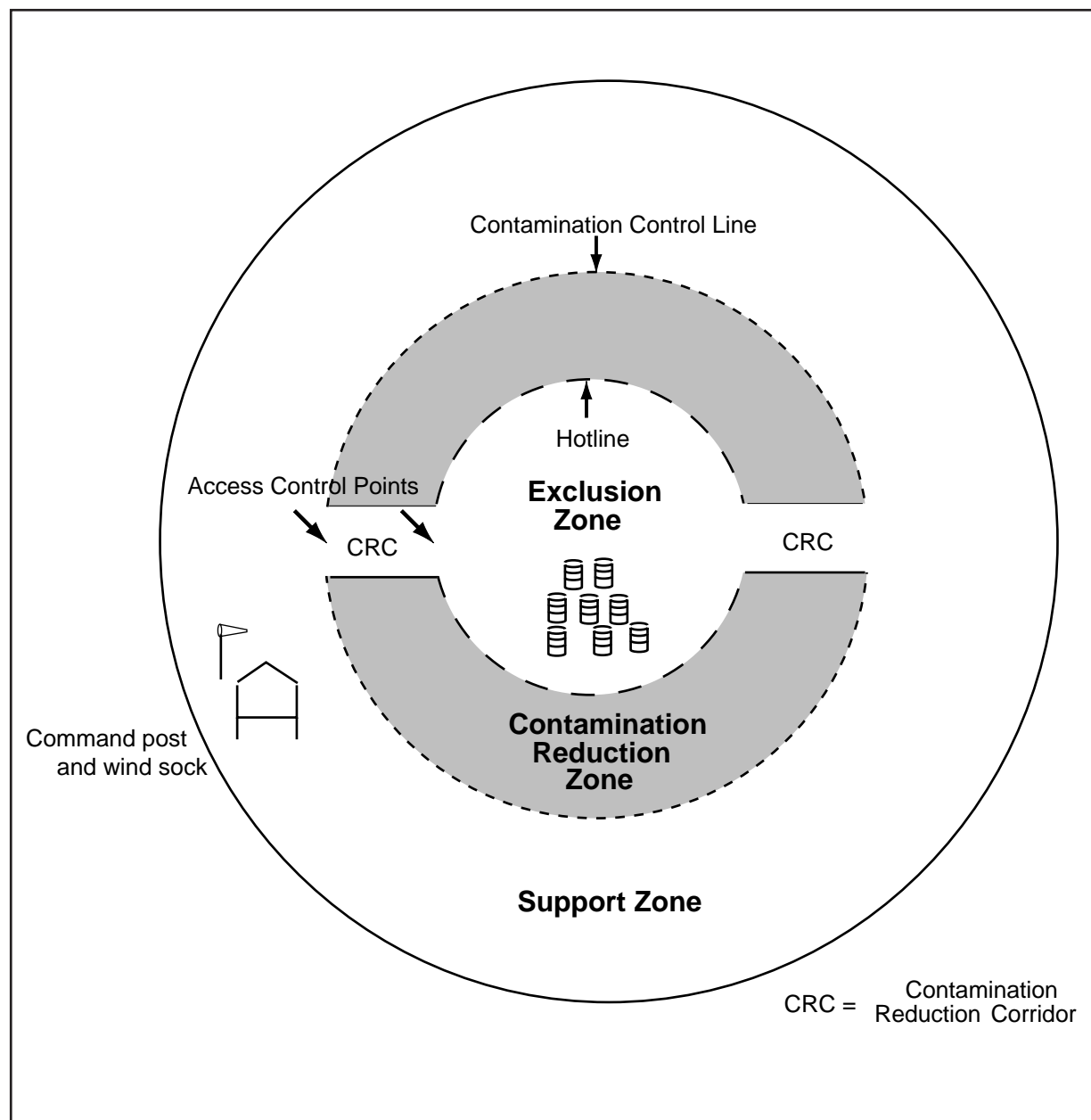
One method of preventing or reducing the movement of contaminants is to identify zones on the site in which various types of operations occur. Movement of personnel and equipment between zones and onto the site itself is limited by access control points. Normally three adjoining zones are used:

1. Exclusion zone
2. Contamination reduction zone
3. Support zone

Figure 6-1 illustrates the different areas of a hazardous waste site.

**Exclusion Zone**

The *exclusion zone* is the area where hazardous waste clean-up work takes place and where contamination occurs. It is the innermost of the three zones and is commonly called the *hot zone*. Everyone who enters the exclusion zone must wear the appropriate level of PPE. An entry and exit *access control point* must be established at the boundary of the exclusion zone. The access control points regulate the flow of personnel and equipment into and out of the zone and confirm that the correct entry and exit procedures are followed.



**Figure 6-1.** A hazardous waste site with three work zones and two contamination reduction corridors.

The outer boundary of the exclusion zone is the *hot line*. Initially the hot line is established by visually identifying the location(s) of hazardous substances and drainage, leachate, or spilled material. Data from the initial survey is used to help determine boundaries.

The following factors are considered when determining boundaries:

- Distances needed to prevent fire or explosion from affecting personnel outside the zone.
- Physical area necessary to conduct site operations.
- Potential for contaminants to be blown from the area.

Once the hotline has been determined, it should be physically secured, fenced, or well defined by landmarks. As operations proceed, the boundary may be relocated as information becomes available from hazard assessment or monitoring.

#### *Sub-Areas Within*

Conditions within the exclusion zone may vary from one location to another location. The type of work to be done or the hazards that might be encountered create sub-areas within the exclusion zone. These sub-areas may require different levels of PPE depending upon the conditions. Sub-areas are specified and clearly marked as to whether Level A, B, or C protection is required.

Different levels of protection in the exclusion zone might also be designated by job assignment. For example, collecting samples from open containers might require Level B protection, while Level C protection might be sufficient for walk-through ambient air monitoring. When appropriate, the assignment of different PPE levels within the exclusion zone generally makes for a more flexible, effective, and less costly operation while still maintaining a high degree of safety.

### Contamination Reduction Zone

Between the exclusion zone and the support zone is the *contamination reduction zone (CRZ)* which provides a transition between the contaminated and clean areas. The CRZ provides additional assurance that the physical transfer of contaminants on people, equipment, or in the air is limited through a combination of the following:

- Decontamination
- Distance between the exclusion and support zones
- Zone restrictions
- Work functions

Decontamination procedures take place in designated areas within the CRZ which are called contamination reduction corridors (*CRC*). The CRC begins in the hot zone. Normally there are two CRCs, one for personnel and one for heavy equipment. Larger operations may use more than two corridors. Exit from the exclusion zone must be through a CRC.

As operations proceed, the area around the decontamination station may become contaminated, but to a much lesser degree than the exclusion zone. The amount of contaminants should decrease from the hot line to the support zone due to the distance involved and the decontamination procedures used.

The boundary between the support zone and the CRZ is the contamination control line. It separates the CRZ from the clean support zone. Entry to the CRZ from the support zone is through an access control point. Personnel entering this area **must** wear the prescribed PPE for working in the CRZ. Entering the support zone requires removal of any PPE worn in the CRZ.

The CRZ must be well designed to facilitate:

- Decontamination of equipment, personnel, and sampling containers.
- Emergency response:
  - Transport for injured personnel (safety harness, stretcher).
  - First-aid equipment (bandages, blankets, eye wash, splints, and water).
  - Containment equipment (absorbent, fire extinguisher).
- Equipment resupply:
  - Air tank changes
  - PPE (booties and gloves)
  - Sampling equipment (bottles and glass rods called thieves)
  - Tools
- Sample packaging and preparation for on-site or off-site laboratories.

## Support Zone

The outermost part of the site is the *support zone*. The support zone is considered a noncontaminated or clean area. Support facilities are located in this zone and include the command post, equipment trailer, offices, toilets, shower, etc. Access to the support zone is restricted to authorized response personnel. Since normal work clothes are appropriate within this zone, potentially contaminated clothing, equipment, and samples are not permitted. Contaminated items are left in the CRZ until they are decontaminated.

The command post is always located in the support zone. It should serve as the communication center for all on-site and off-site activities relative to the operation.

The location of the command post and other support facilities within the support zone depends on a number of factors, including:

- **Accessibility:** land surface characteristics, open space availability, locations of highways and railroad tracks, or other limitations.
- **Wind direction:** The support facilities should be located upwind of the exclusion zone. However, shifts in wind direction and other conditions may mean an ideal location based on wind direction alone does not exist.
- **Resources:** adequate roads, power lines, water, and shelter.

## **Buddy System**

Most activities in contaminated or otherwise hazardous areas shall be conducted using the buddy system (or in a group or team) who is able to perform the following activities:

- Provide co-worker assistance.
- Observe co-worker for signs of chemical or heat exposure.
- Periodically check co-worker's protective clothing.
- Notify appropriate personnel if emergency help is needed.

The access control point for personnel entrance to the exclusion zone is a convenient location for enforcing the buddy system. All personnel who enter the contaminated areas must pass through the access control point.

The buddy system alone may not be sufficient to ensure that help will be provided in an emergency. At all times, workers in the exclusion zone should be in line-of-sight contact or communication contact with the command post supervisor or a back-up person in the support zone.

**Site Security**

Effective site security is important for the following reasons:

- Prevents exposure of unauthorized, unprotected people to site hazards.
- Protects against vandals or persons illegally abandoning waste on the site.
- Prevents theft.
- Promotes safe working procedures.

Site security can be maintained during working hours by following these directives:

- Maintain security in the support zone and at access control points.
- Establish an identification system to identify unauthorized persons.
- Assign responsibility for enforcing authority for entry and exit requirements.
- Erect a fence or other physical barrier around the site.
- If a site is not fenced, post signs around and have guards patrol the perimeter.

**Site Communications**

Two communication systems should be established on a hazardous waste site:

1. External communication between on-site and off-site personnel
2. Internal communication among personnel on the site.

- External Communication      The external communication system allows on-site personnel to contact the community hospital, fire department, or rescue team. The internal communication system is used to:
- Notify team members of emergencies.
  - Communicate changes in work.
  - Maintain site control.
  - Pass along safety information, such as the amount of air, time left before the next rest period, air change, or heat stress check.

Communicating on a hazardous site has its difficulties. Background noise and the use of PPE can obstruct verbal communication on the site. For example, talking through a respirator is difficult, and hearing is impaired by protective hoods and respirator air flow. Audio or visual cues can help convey messages, but cues must be prearranged and known by all workers for communication to be effective.

- Internal Communication      Examples of common internal communication devices include:
- Radios
  - Audio signals, such as bells, sirens, or whistles
  - Visual signals, such as flags, hand signals, or lights

## **EMERGENCY RESPONSE**

The best way to deal with emergencies is to prevent them. On a well-run site, emergencies should be few and far between. But it is not possible to totally eliminate the chance of an emergency. This makes basic planning and worker training very important. A hazardous waste site involves conditions which make mishaps and rescues more complicated. Communication is more difficult than usual. The possibility of dangerous conditions makes mistakes more costly. Hazards may not be obvious. There are many things that can go wrong. Advance training is the best way to limit the damage done by any emergency.

Although no studies have been done on specific hazardous waste emergency problems, NIOSH studied 25 cases where emergencies developed in situations involving chemicals and confined spaces. In 19 of the 25 cases where rescue was attempted, rescuers were either killed or injured. These 19 cases involved 13 deaths and 30 injuries to the rescuers. Only 5 of the original victims were saved. This study provides a powerful example of why emergency procedures and training must be put together at every waste site.

The basic causes of emergencies are divided into two basic types:

1. Waste-related emergencies:
  - Fire
  - Explosion
  - Collapse of containers
  - Leaks and spills
  - Presence of radioactive materials
  - Release of toxic vapors
  - Reaction of incompatible chemicals
2. Worker and site-related emergencies:
  - Minor accidents such as slips or falls
  - PPE failure
  - Chemical exposure
  - Medical stress such as heat
  - Major accident (vehicle accident or electrocution)

### **Emergency Response Plan**

OSHA regulations requires an emergency response plan be developed and implemented by employers to handle anticipated emergencies prior to the start of any hazardous waste operation. The plan shall be in writing and available to all employees, their representatives, and any government agencies involved. As a minimum, the emergency response plan shall contain the following:

- Advance planning
- Assign personnel roles
- Site map for emergencies
- Communication and locator systems
- Equipment needs
- Training and drills
- Escape routes, refuges, and self-rescue procedures

- Emergency response procedures
- Request for off-site assistance
- Follow-up
- Emergency aid and medical treatment

Many of these elements are discussed in the following paragraphs and others are shown in the emergency response section of the mock site safety and health plan.

#### Advance Planning

The best way to deal with emergencies is to plan ahead. A plan can serve to set out procedures for handling a variety of situations. By describing the roles to be played by different personnel, the plan can ensure teamwork instead of life-threatening delays. The plan also can be used to train all site employees and be the basis for mock drills so that all parties become familiar with procedures. In recognizing the value of advance planning, the regulations require that every site-specific safety and health plan include an emergency response plan.

#### Assign Personnel Roles

The plan must identify all the individuals and teams who will participate in emergency operations. The lines of authority must be clear, so that everyone knows who is in charge, and what each person must do. One person must be put in control of the program, although a back-up person is also needed. A team approach is often used where several individuals will be assigned as the rescue team or a first-aid team. The plan should include off-site support teams, such as ambulance services, firefighters, and other contacts.

#### Site Map for Emergencies

To avoid any confusion, it is important to have a site map ready at all times to be used for emergency purposes. The map should show information on:

- Hazard areas
- Site terrain
- Access roads
- Nearby homes
- Evacuation routes
- Location of emergency and first-aid equipment
- Location of refuges

## Communication and Locator Systems

In an emergency, the need for effective communication is very important. Yet communications on a waste site may be severely limited because PPE makes speaking difficult. Also, outside communication is important. The emergency response plan must address this issue with an effective system. Radios or field telephones are often used. Bull horns, air horn, whistles, hand signals, and colored flags are all good back-up systems. The method chosen must be clearly understood by all, and practiced during drills. It is also important to have a special set of emergency signals to get attention in a hurry.

A locator system is also needed for any sound emergency plan. Every hazardous waste site must have at least a basic locator system. This is usually a site map in the command post in the support zone area. The names and locations of workers going on the site are listed on the entry board, then taken off when the workers leave the site. Whatever system is used, it must be:

- Written down
- Kept current
- Easy to find
- Located outside of the hot zone
- Able to identify workers' locations

A simple system using pins or written entries is called a passive locator system. Systems which use radios or transmitters worn by individual workers are known as active locator systems. A locator system is an important part of any emergency plan and having a checkpoint system is important for ensuring a safe site. It is typical for the checkpoint control person to record the following information:

- Name of person
- Status (in or out)
- Time of entry
- Anticipated exit time
- Zone or area to be entered
- Name of buddy or team
- Task to be performed
- Location of task

Equipment Needs	<p>The response plan must address the need for rescue equipment. It must describe where equipment is kept and when it's to be used. Level A equipment should be kept even if the job uses Level C equipment. Extra air tanks and escape SCBAs are also important emergency equipment. First-aid equipment and canvas stretchers are needed for emergency situations at any hazard site. Basic firefighting equipment is also common.</p>
Training and Drills	<p>An emergency plan is not meaningful unless training and drills are done on a regular basis. All training records should be kept on site and training should meet the following guidelines:</p> <ul style="list-style-type: none"><li>• Be directly related to possible emergencies at that site</li><li>• Be brief but repeated often</li><li>• Provide an opportunity for skills to be practiced</li><li>• Be as realistic as possible and include everyone</li></ul>
Escape Routes, Refuges, and Self-Rescue	<p>One important part of developing an emergency plan is to consider ways in which workers in the hot zone can get to safety in case of a problem. There are two different ways to provide safety:</p> <ol style="list-style-type: none"><li>1. Arrange for escape routes</li><li>2. Provide safety stations in the site area</li></ol>
<i>Escape Routes</i>	<p>Normally, workers exit through the established decontamination line. However, it is possible that a severe problem, such as a fire or explosion, could cut workers off from this exit. Because of this, it is typical to provide two or more evacuation routes at different ends of the site. These escape routes may change if wind direction changes. In the event of an emergency, the worker locates the area of the incident, and then selects an evacuation path that is upwind of the involved area.</p> <p>Besides wind direction, the suitability of the terrain plays a big part in choosing an escape route. Streams, elevated areas, and other barriers make escape difficult for workers in heavy protective gear. If barriers block easy access for workers in PPE, another route must be chosen. Cleated ramps (chicken boards) with railings should be provided over streams or ditches. Plenty of ladders should be available when work is done in</p>

trenches. Areas which might be mistaken for escape routes in an emergency should be marked off. If the site has buildings or confined areas with manholes or hatches, consideration must be given to the size of the openings. They must be large enough for workers with PPE to be able to maneuver through.

The escape routes should be marked on the site map so that work crews are aware of them as they enter the work area.

### *Refuges*

A refuge is a safety station set up to provide relief in emergency situations that do not call for evacuation. It is located in a relatively safe area, such as upwind in a specially cleared spot. In addition, the refuge can be used to take a short break, to meet with other crew members, or get relief from mild heat stress. The refuge is **never** used for eating, drinking, smoking, or air changes. The refuge may include some basic items such as:

- A sitting or resting area, shaded if possible
- Wind indicator
- First-aid supplies
- Decontamination supplies
- Communication equipment
- Air monitoring devices
- Bolt cutters and hand tools
- Fire extinguishers

Depending on the site setup, a refuge may be located in the support zone, as well as near the safe exit off the site. This type of refuge is used in case the entire site must be evacuated. It has the same type of supplies, plus extra air tanks.

### *Safe Distances*

In some types of emergencies where chemical releases are likely, evacuation may involve moving a safe distance away from the chemical. Different safe distances have been prescribed for different chemicals, depending on how toxic they are and how easily they disperse (scatter or break up). There are computer programs that can predict the movement of chemicals, given temperature, wind direction, and other conditions. For example, a small chlorine leak might call for a safe distance of 140

feet, but a large chlorine leak might require evacuation of a one-mile area. Safe distances for typical and worst case situations are sometimes developed as part of emergency response plans.

#### Emergency Response Procedures

Emergency response plans include a basic sequence to be followed to ensure that response is done in an orderly and complete manner. A typical sequence is notification, evaluation, and response.

#### *Notification*

Every worker has a responsibility to sound an alarm if they notice a problem. It is important to provide the basic details:

- WHAT happened?
- WHERE did it happen?
- WHO did it happen to?
- WHEN did it happen?
- HOW did it happen?
- TO WHAT EXTENT did it happen?
- WHAT HELP is needed?

#### *Evaluation*

The next step is to use the above information to deal with the situation. This is where training, judgment, and experience are valuable. The chain of command must answer the following questions:

- What type of incident has occurred?
- What are the casualties?
- What could happen next?
- What can be done to deal with the situation?

During a medical emergency, the primary concern is to prevent injury or death to site personnel. Therefore, the decision to decontaminate a worker is based upon that concern:

- Do not decontaminate if immediate medical treatment is needed to save a life. Wait until the victim is stabilized.
- Decontaminate when it doesn't interfere with essential lifesaving techniques or first aid.

- Decontaminate immediately when a worker has been contaminated with an extremely toxic or corrosive material that could cause severe injury or loss of life.

If an emergency due to a heat-related illness develops, protective clothing should be removed from the victim as soon as possible to reduce the heat stress. The decision to decontaminate will depend upon the severity of the heat-related illness.

### *Response*

Based on the evaluation of the incident, the appropriate people in the chain of command must determine what response actions are to be started. This is where teamwork and planning pay off. Typical response actions might be:

- Send in rescue teams to bring out injured personnel
- Mobilize the firefighting brigade
- Start spill containment
- Send in personnel to neutralize chemicals
- Request off-site assistance

For the above actions, provisions should be made for:

- Decontaminating victims
- Protecting the medical personnel
- Disposing of contaminated PPE and wash solutions

### *Request For Off-Site Assistance*

The emergency response plan must take into account the availability of emergency organizations in the surrounding communities. No site can afford to staff an on-site medical or firefighting facility, but normally many emergency services are available in an area. The agencies should be contacted before the response plan is written, their capabilities established, and plans developed for their assistance. The response plan should list the names and telephone numbers of the appropriate agencies or people to be called.

### *Follow-up*

Follow-up is where the entire emergency is reviewed prior to restarting work. It may be necessary to restock supplies, notify government agencies, and revise the emergency response plan. Follow-up is also the time to identify the cause of the emergency to ensure that it does not happen again.

**Emergency Aid and  
Medical Treatment**

First aid and emergency treatment are central to a successful program. Plans for first aid should be part of the site medical program. A first-aid team must be established, so that there are always some individuals on the site with advanced first-aid ability. The first-aid station should be located next to the clean end of the decontamination area. Arrangements must be made for a doctor who can be paged on a 24-hour basis. The doctor should have ready access to the information about the chemicals on the site and the workers' medical histories. All first-aid personnel must be aware of the emergency response for heat stress problems. Emergency drills should be held on a regular basis.

**INCIDENT  
REPORTING**

State, federal, and local laws or regulations often require that most incidents or emergencies occurring at waste sites be reported to the appropriate agency(ies). The response plan should give procedures for handling the incident and reporting it to the appropriate agencies.

Equally important, and probably requiring more immediate action, is alerting or advising the local communities and surrounding population. People near waste sites are often fearful of the site. Therefore, it is important for them to know promptly what is happening and whether or not the incident is a threat to the surrounding area. If there is no established procedure for notifying neighbors of an incident or if the procedure is not used promptly, many neighbors will assume that any incident is a disaster.

**STANDARD  
OPERATING  
PROCEDURES**

SOPs are required procedures for performing the variety of work associated with activities at hazardous waste sites. SOPs may be administrative, technical, or management-oriented. Workers have encountered procedures of these types in other work activities in which they have been involved (e.g., construction, maintenance). Such procedures are used to provide uniform instructions for accomplishing a specific job.

Safety SOPs are also part of most types of work workers have encountered before. However, at hazardous waste sites, knowing the safety SOPs is a major part of the preparation for hazardous waste work. Unknown conditions, the large number of potentially hazardous chemicals, and the different hazards (i.e., toxic, radiation, fire, and explosion) require the development of extensive and comprehensive SOPs. These are more complicated than those needed for routine and predictable conditions such as asbestos removal.

### **Development of Standard Operating Procedures**

The major consideration in developing SOPs for a remediation project is the health and safety of site personnel. Work must be done efficiently and in a manner that protects the worker, the surrounding environment, and the residents of the community. The right equipment, trained personnel, and standard operating procedures help reduce the possibility of harm to site personnel. For SOPs to be effective, they must be:

- Written in advance. Developing and writing safe, practical SOPs is difficult when responding to an actual situation.
- Based on the best available information, operational principles, and technical guidance.
- Field-tested, reviewed, and revised when necessary by competent safety professionals.
- Used for training and periodic retraining of personnel.

Many of the SOPs involved in hazardous waste site clean-up activities are concerned primarily with health and safety. In concept and principle, these SOPs are general in nature and independent of the type of site or incident. They are then adapted or changed to meet site-specific requirements so that on-site personnel are protected during clean-up operations.



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**SECTION 6 - ASSIGNMENT SHEET**

1. List the ten minimum requirements of a site safety and health plan.

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2. List four examples of unusual hazards that would make it necessary for additional special training.

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3. Identify the following acronyms:

CRZ \_\_\_\_\_

CRC \_\_\_\_\_

S&HO \_\_\_\_\_

4. List the two basic types of emergencies on a hazardous waste site and give four examples of each.

_____	_____
	_____
	_____
	_____
_____	_____
	_____
	_____
	_____

5. List the five important elements of an emergency response plan.

_____
_____
_____
_____
_____

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**APPENDIX 6-1**  
**SAFETY AND HEALTH PLAN FOR A MOCK SITE**

Actual safety and health plans vary widely in length and detail depending on the size and complexity of any given clean-up site. One could be brief (20–30 pages) for a simple site and still cover all the essentials. However, the plans for most sites are much longer (100 to 150 pages) because of the complex nature of most sites.

The following site safety and health plan is for the mock site where you will be the doing the exercises associated with this course. You should review this plan with your instructors and fill in all the blanks. This is your safety and health plan so review it in some detail to better understand what the plan contains, and to make sure that you know how to read and understand the information provided.

**SAFETY AND HEALTH PLAN****for the****MOCK SITE****at**

Prepared for: \_\_\_\_\_

By: Laborers-AGC Education and Training Fund

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**SAFETY AND HEALTH PLAN**

\_\_\_\_\_ **MOCK SITE**

**at**  
\_\_\_\_\_

**1.0 INTRODUCTION**

This Safety and Health Plan (hereinafter called the PLAN) describes the program to be implemented by \_\_\_\_\_ Construction, Inc. (hereinafter called the Contractor) when performing remediation work for the Laborers-AGC at the \_\_\_\_\_ Mock Site in \_\_\_\_\_.

Safeguarding the Contractor's employees, subcontractors, and neighbors in the adjacent communities is a key part of this project. All work will be conducted in accordance with applicable federal, state, and local regulations (OSHA, EPA, etc.).

This PLAN identifies procedures to be followed to minimize the potential for personnel exposure to contaminants known to be or suspected of being present at the site. All Contractor's employees and subcontractors who perform field work during the project will be required to read this PLAN, acknowledge receipt and understanding of this PLAN by signing Attachment C, and submit it to the Contractor's Project Manager before performing any field activities.

**2.0 KEY PERSONNEL**

The Contractor's Project Manager, \_\_\_\_\_, has the primary responsibility for all on-site activities associated with the remedial (clean-up) work to be done at the \_\_\_\_\_ Mock Site. Although safety and health is the responsibility of all personnel working at the Site, primary responsibility for the Safety and Health Program is assigned to the Safety and Health Officer (S&HO).

**2.1 *Safety and Health Officer***

The S&HO is \_\_\_\_\_, and his/her telephone number is (\_\_\_\_\_) \_\_\_\_\_. The S&HO has overall responsibility for the implementation of this PLAN and the approval of any changes, modifications, and/or additions to it. He/she has authority to:

- Upgrade protection levels as required
- Suspend work due to Safety and Health Program violations, health-related incidents, and other increased risk situations
- Remove personnel from the work site if their actions endanger the health and safety of other field personnel
- Authorize personnel to enter the site based on medical and training requirements

The S&HO's responsibilities are:

- Implement the Site Safety and Health Plan
- Conduct Site inspections to monitor compliance with the approved PLAN
- Provide or coordinate training sessions
- Coordinate the Medical Monitoring Program
- Conduct respirator fit tests as required
- Coordinate the acquisition, calibration, and maintenance of air monitoring equipment, respirators, and other safety equipment
- Direct on-site health and safety activities
- Report safety-related incidents or accidents to the Project Manager and fill out lost time incident forms as required
- Perform or oversee performance of all air monitoring activity
- Maintain or oversee maintenance of on-site health and safety equipment

## 2.2 *Environmental Protection Agency*

The EPA Project Coordinator for this project is \_\_\_\_\_ and his/her telephone number is ( \_\_\_\_ ) \_\_\_\_\_.

## 2.3 *Medical Contacts*

The local physician in \_\_\_\_\_ is \_\_\_\_\_ and his/her telephone number is ( \_\_\_\_ ) \_\_\_\_\_.

The local emergency contacts are:

Fire Chief \_\_\_\_\_ telephone # (\_\_\_\_) \_\_\_\_\_

Police Chief \_\_\_\_\_ telephone # (\_\_\_\_) \_\_\_\_\_

Emergency Ambulance Service \_\_\_\_\_ telephone # (\_\_\_\_) \_\_\_\_\_

When contacting the Emergency Ambulance Service inform the dispatcher of the specific hazard to ensure that if the injured person is contaminated, he/she will not be rejected.

The local hospital is \_\_\_\_\_ telephone #(\_\_\_\_) \_\_\_\_\_

### 3.0 SITE DESCRIPTION AND HISTORY

The \_\_\_\_\_ Mock Site is located approximately 1 mile outside of \_\_\_\_\_ (See Attachment F) and occupies an area of approximately \_\_\_\_\_ acres. The site is \_\_\_\_\_.

Beginning in 1970, the Site was used by the Badguy Solvent Company for the handling, recovery, and disposal of various oils and solvents. In the ensuing years, acids, bases and miscellaneous materials and trash also accumulated at the site. Initially, oils and solvents were reclaimed by distillation and/or chemical treatment with the residues from these treatments disposed of on-site. The site was abandoned in 1983 and has been idle since that date.

As a result of complaints by neighboring residents and the local agencies, the EPA investigated the site in 1986. The investigation disclosed the presence of hazardous materials on the site in various containers, some of which were in imminent danger of failure because of deterioration (rust, etc.). In July 1986, an EPA contractor undertook a Removal Action to remove from the site those containers, etc., that posed an immediate threat to health and the environment. This removal action was completed. Additional site investigations were undertaken by EPA to determine the remaining hazards at the site and \_\_\_\_\_. Construction was awarded a contract to complete cleanup of the site.

### 4.0 HAZARD DESCRIPTION

#### 4.1 Waste Characterization

Wastes disposed of at the site and found to be present in samples taken during the site investigation phase contain the following materials:

- Arsenic
- Benzene
- Chromium
- Diesel and kerosene mixture
- Methyl ethyl ketone
- Peroxide
- Polychlorinated biphenyls
- Sulfuric acid
- Trichloroethylene
- Waste oil

These wastes may be found as liquids in drums, tanks, or disposal ponds or as contaminants in the soils, tank sludges, or pond sediments at the site. Investigation has shown that a number of these contaminants have penetrated into the soil to depths of up to ten feet.

Chemical and toxicological characteristics of cutting oil, fecolic acid, and peroxide are contained in the Hazardous Substance Information Forms found in Attachment D.

## 5.0 FIELD ACTIVITIES

Activities associated with this clean-up project include:

- Removal of all liquids in drums that are stored on the site in the warehouse or are buried. Buried drums must be excavated. Opening of drums with unidentified contents and sampling prior to staging for removal.
- Removal of sludges and sediments from the bottom of tanks.
- Sampling the tanks.
- Staging of drums that contain compatible materials and are to be disposed of by the same method. Building of dikes (or berms) for staging areas, using plastic to prevent spreading of contamination.
- Overpacking drums that are found to be leaking or in such a deteriorated condition that further handling would be hazardous. Pumping contents of deteriorated drums into new drums when drum movement is impossible.
- Soil sampling.
- Sampling groundwater monitoring wells (bailing).
- Patching leaking drums.
- Sampling pond sediment.
- General site cleanup and organization.

For purposes of this PLAN, the activities to be carried out in this cleanup have been grouped, based on the degree of contact that field workers are likely to have with the contaminated wastes. These groupings may be revised by the S&HO if on-site observations or monitoring indicate they are not providing adequate protection. It is the responsibility of the site S&HO to assess any deficiencies found in the protection of field workers, suspend work if necessary to protect workers, and revise procedures (protection levels) if any are found to be inadequate.

The following field activities are grouped by degrees of exposure:

### 5.1 *No Waste Contact Activities*

Activities that involve no contact with contaminated materials include:

- Road and fence repairs
- Security services

### 5.2 *Limited Waste Contact Activities*

Activities that involve indirect or potential for contact with waste include:

- Construction of temporary staging/storage areas

- Decontamination of debris
- Collection, pre-treatment, and disposal of contaminated water (from decontamination operations)
- Excavation, grading, and general maintenance of site within the Exclusion Zone but not in areas close to sources of hazardous waste

### 5.3 *Direct Waste Contact Activities*

Activities that involve direct contact with contaminated wastes include:

- Waste excavation
- Drum opening and sampling
- Drum (container) handling, overpacking, pumping out
- Decontamination of equipment and personnel
- Waste bulking
- Pond and soil sampling
- Tank entry, sludge sampling, and removal
- Air monitoring within the Exclusion Zone

## 6.0 HAZARD ASSESSMENT

An assessment of hazards has been made for each of the groups of activities to be carried out in the cleanup.

### 6.1 *No Waste Contact Activities*

For activities that involve no waste contact, the primary hazards are the physical hazards associated with construction, the use of heavy equipment, and heat and cold stress.

### 6.2 *Limited Waste Contact Activities*

For activities that involve only indirect or the potential for contact with waste, the following hazards have been identified and shall be protected against:

- Physical hazards associated with construction, material handling, and the use of equipment while wearing personal protective equipment (PPE)
- Heat and cold stress
- Inhalation of low concentrations of vapors or mists from acids, peroxides, or organic solvents
- Limited skin or eye contact with acids, peroxides, oils, and organic solvents
- Fire hazards due to presence of organic solvents
- Reaction hazards due to presence of acids and peroxides
- High pressure hoses and liquid transfer equipment
- High noise areas

### 6.3 *Direct Waste Contact*

For activities that involve direct waste contact, the following hazards have been identified and shall be protected against:

- Physical hazards associated with construction, material handling, and the use of equipment while wearing PPE
- Heat and cold stress
- Inhalation of low concentrations of vapors or mists from acids, peroxides, or organic solvents
- Extensive skin or eye contact with acids, peroxides, oils, and organic solvents
- Ingestion of acids, peroxides, oils, and/or organic solvents
- Fire hazards due to presence of organic solvents
- High pressure hoses and liquid transfer equipment
- High noise area
- Chemical reactions due to presence of acids and peroxides

### 6.4 *Special Situations*

Since the site handled a wide range of chemicals during its years of operation, and the site investigations carried out to date may not have found and identified all the possible contaminants present at the site, the following additional precautions will be taken:

- Opening and sampling of any drums whose contents are not identified will be carried out under the surveillance of the S&HO, or his/her designee, who will establish the appropriate level of PPE for this operation.
- Moving, handling, pumping out, or overpacking any drum or other container whose contents have not been identified will be done only after the S&HO has established the appropriate level of PPE for the operation.

## 7.0 PERSONNEL PROTECTIVE EQUIPMENT

It is important that PPE is appropriate to protect against the potential or known hazards at the Site. Protective equipment has been selected based on the types and concentrations of substances at the site and the possibilities for and the routes of personnel exposure. The following levels of protection are required for the following activity groups.

Activity	Level of Protection
No waste contact activities	D
Limited waste contact activities	C
Direct waste contact activities	C/B

### 7.1 Level A Protection - PPE

If the situation develops where Level A PPE is required the following will be required:

- Atmosphere-supplying respirator (MSHA/NIOSH approved). Respirators may be pressure-demand self-contained breathing apparatus or pressure-demand airline (with escape bottle for IDLH or potential for IDLH atmosphere)
- Fully-encapsulating, chemical-resistant suit
- All other equipment is the same as Level B

### 7.2 Level B Protection - PPE

- Atmosphere-supplying respirator (MSHA/NIOSH approved). Respirators may be pressure-demand self-contained breathing apparatus or pressure-demand airline (with escape bottle for IDLH or potential for IDLH atmosphere)
- Chemical-resistant clothing. Clothing may be hooded, one- or two-piece chemical-splash suit; disposable chemical-resistant one-piece suits (Saranex®)
- Cotton long underwear\*
- Gloves (outer), chemical-resistant
- Gloves (inner), chemical-resistant
- Boots (outer), chemical-resistant, steel toe and shank
- Boot covers (outer), chemical-resistant (disposable)\*
- Hard hat (face shield)\*
- Hearing protection\*

*\* Indicates optional equipment*

### 7.3 Level C Protection PPE

- Air-purifying respirator, full face, cartridge-equipped (DHHS/NIOSH approved)
- Chemical-resistant clothing. Clothing may be hooded, one- or two-piece chemical-splash suit; disposable chemical-resistant coveralls
- Coveralls
- Cotton long underwear\*
- Gloves (outer), chemical-resistant
- Gloves (inner), chemical-resistant
- Boots (outer) chemical-resistant, steel toe and shank
- Escape mask\*
- Hearing protection\*

*\* Indicates optional equipment*

#### 7.4 *Level D Protection - PPE*

- Coveralls
- Gloves
- Boots/shoes, leather or chemical resistant, steel toe and shank
- Safety glasses or chemical splash goggles
- Hard hat (face shield)\*
- Hearing protection\*

*\* Indicates optional equipment*

### 8.0 **SITE CONTROL**

#### 8.1 *Site Access*

Access to the \_\_\_\_\_ Mock Site activities will be limited to authorized personnel. Such personnel include the Contractor's employees, designated equipment operators, and designated Laborers-AGC representatives. However, access into the established exclusion zone will be limited to personnel wearing appropriate PPE. The exclusion zone will be cordoned off with flagging tape or other suitable indicators designating the exclusion zone boundary. The zone will also be monitored by the S&HO to ensure individuals do not enter without proper personal protection.

Sign-in procedures may be implemented to ensure that authorized personnel only will participate in the clean-up activities. The Site Project Manager will coordinate this effort and maintain the generated documentation accordingly.

#### 8.2 *Site Control*

The \_\_\_\_\_ Mock Site is not entirely secured by fencing or other suitable site control means, and the site is not routinely patrolled by police or any independent security department. Thus, certain procedures must be followed to ensure suitable site control and limitation of access so persons who may be unaware of site conditions are not exposed to inherent hazards.

All excavations left open and unattended by site personnel will be appropriately barricaded and visibly posted with "No Trespassing" or other appropriate signs. Well caps will be secured by suitable locking devices to prevent unauthorized access. All heavy machinery and equipment shall be locked or chained each evening upon completion of daily activities. Lastly, all potentially contaminated media, such as purged groundwater, cuttings, and soils, will be covered with plastic prior to leaving the site each day.

#### 8.3 *Work Zones*

To restrict the movement of contaminants from the Site to uncontaminated areas, three work zone areas shall be set up and appropriately marked (see Attachment G).

The three work zones shall be as follows:

- Zone 1: Exclusion Zone

The exclusion zone is the zone where contamination does or could occur. All persons entering this zone shall wear the level of protection set forth in the Hazard Assessment Section and prescribed by the S&HO. (Level C is minimum.)

- Zone 2: Contamination Reduction Zone

The contamination reduction zone provides a transition between contaminated and clean areas of the Site. This zone shall be located directly outside the Exclusion Zone. All personnel and equipment leaving the Exclusion Zone shall be decontaminated in this zone. Procedures for decontamination are specified in Section 11.

- Zone 3: Support Zone

The support zone shall be an uncontaminated area from which operations shall be directed. It is essential that contamination be kept out of this area.

## 9.0 MEDICAL MONITORING PROGRAM

### 9.1 *Pework Assignment Physical Examination*

The Contractor requires all of its field workers to pass comprehensive pre-employment medical examinations prior to working at hazardous waste sites. The examination includes:

- Complete medical and occupational history
- Full physical examination
- Vital systems check
- Screening audiometry
- Visual acuity
- Pulmonary function test
- Electrocardiogram
- Chest x-ray
- Blood test including CBC, SMA24 and PCB Blood Levels
- Urinalysis including microscopic
- Drug screen
- Back motion tests

Other special tests as deemed necessary by the Company Physician. A copy of the Medical Certificate is illustrated in Attachment E.

Following the results of the hands-on physical and the laboratory tests, the physician determines whether the employee is:

- Qualified to work in areas where exposure to chemicals or physical stress is possible
- Physically able to use PPE, including respirators

### *9.2 Annual and Exit Examination*

The Contractor conducts an identical program on an annual basis and at employee termination. Additional testing may be conducted when special or unusual conditions exist.

### *9.3 Medical Support Services*

The Company Physicians provide medical consultation services to advise on medical and health questions as they arise and evaluation and care of individuals with work related exposures, injuries, or illness.

### *9.4 Emergency Medical Care and Treatment*

Prior to starting work at the Site, the Contractor will contact local emergency organizations (e.g., hospital, rescue squad, fire department, bomb squad, police) to ensure that they are adequately prepared to respond to potential emergencies.

Emergency telephone numbers, a map, and directions to the nearest medical treatment facility will be conspicuously posted at the Site.

Emergency showers, eye wash fountains, and first aid equipment will be readily available on-site. The S&HO will be certified by the American Red Cross in First Aid and CPR.

In the event of an injury or chemical exposure, employees will be transported to the nearest medical treatment facility. Employees suffering from chemical exposure will be accompanied by a material safety data sheet (MSDS) giving specific information about the chemicals.

## **10.0 TRAINING REQUIREMENTS**

### *10.1 Basic Training*

All employees who perform work at the site must have completed a minimum of 40 hours of training in a hazardous waste site training program as required under 29 CFR 1910.120. In addition to the initial 40-hour training, an 8-hour refresher training course must be taken annually (beginning one year after the 40-hour training was completed).

### *10.2 Site Specific Training*

Employees assigned to the Site will be given a minimum of three days of site-specific training and field experience to include the following topics:

- Acute and chronic effects of the toxic chemicals found at the Site
- Routes of potential exposure and field activities that could result in such exposure
- Need for personal protection, types of protection, its effectiveness and limitations
- Proper use and fitting of respiratory protective equipment

- Medical surveillance program
- Work zones established at the Site
- Prohibited activities in the Exclusion and Contamination Reduction Zone
- Engineering controls and safe work practices associated with each employee's work assignment including dust control measures and use of "buddy system"
- Personal and equipment decontamination procedures
- Emergency response procedures
- Basic operational safety, emphasizing hazards expected on-site
- Drum handling procedures
- Tank/Vacuum trailer loading/unloading
- Spill control
- Sampling procedures
- Site communications

### 10.3 *Emergency Response Training*

Employees will be given emergency response training according to the following:

- Each employee will participate in a site evacuation drill during the first full week of field activities.
- The S&HO, or another member of the Contractor's management designated by the S&HO, having a current first aid and CPR certification (via an established American Red Cross program) will review these procedures.
- At least one member of each work crew shall receive training in the use of portable fire extinguishers in accordance with OSHA regulation 29 CFR 1910.157(g).

## 11.0 **DECONTAMINATION**

### 11.1 *General*

Each time an employee enters the Contamination Reduction Zone from the Exclusion Zone he/she must make a thorough self-examination. Equipment must be removed without exposure to the wearer. Hands and face must be scrubbed before eating or use of tobacco products to avoid accidental ingestion of wastes. Footwear must be changed prior to leaving the Contamination Reduction Zone to avoid "tracking" contamination outside the secure area.

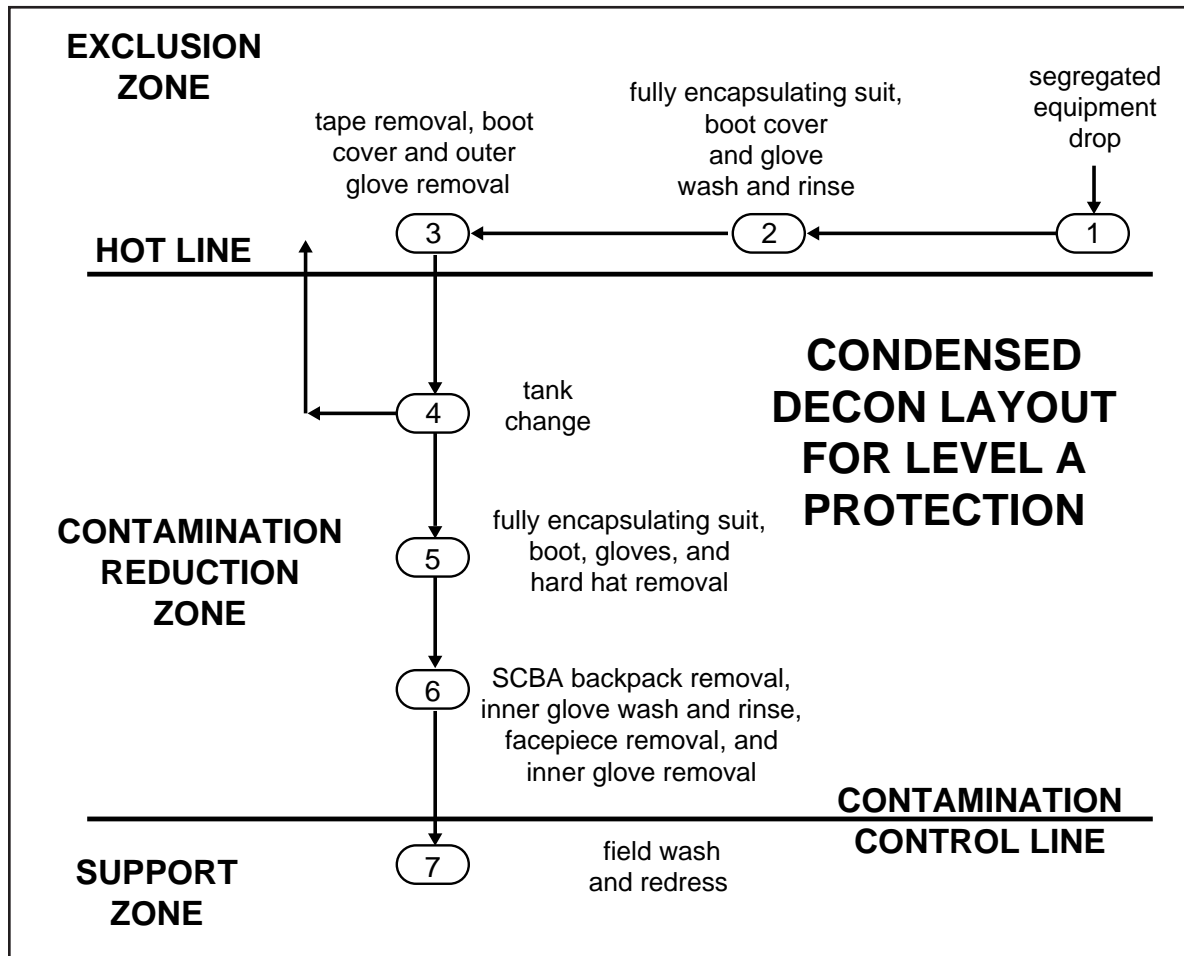
When leaving the Site for the day, or if there is any indication that protective gear has been breached, immediate showering is required. For workers wearing PPE during the work day, showering at the end of the day is recommended for personal hygiene reasons.

Shower facilities will be designed in the same manner as the work areas, with the pre-wash area segregated from the post wash area with work and street clothes carefully separated. Only after satisfactory showering in such a facility may the employee relax his or her vigilance to accidental chemical exposure.

### 11.2 Personnel Decontamination Facilities

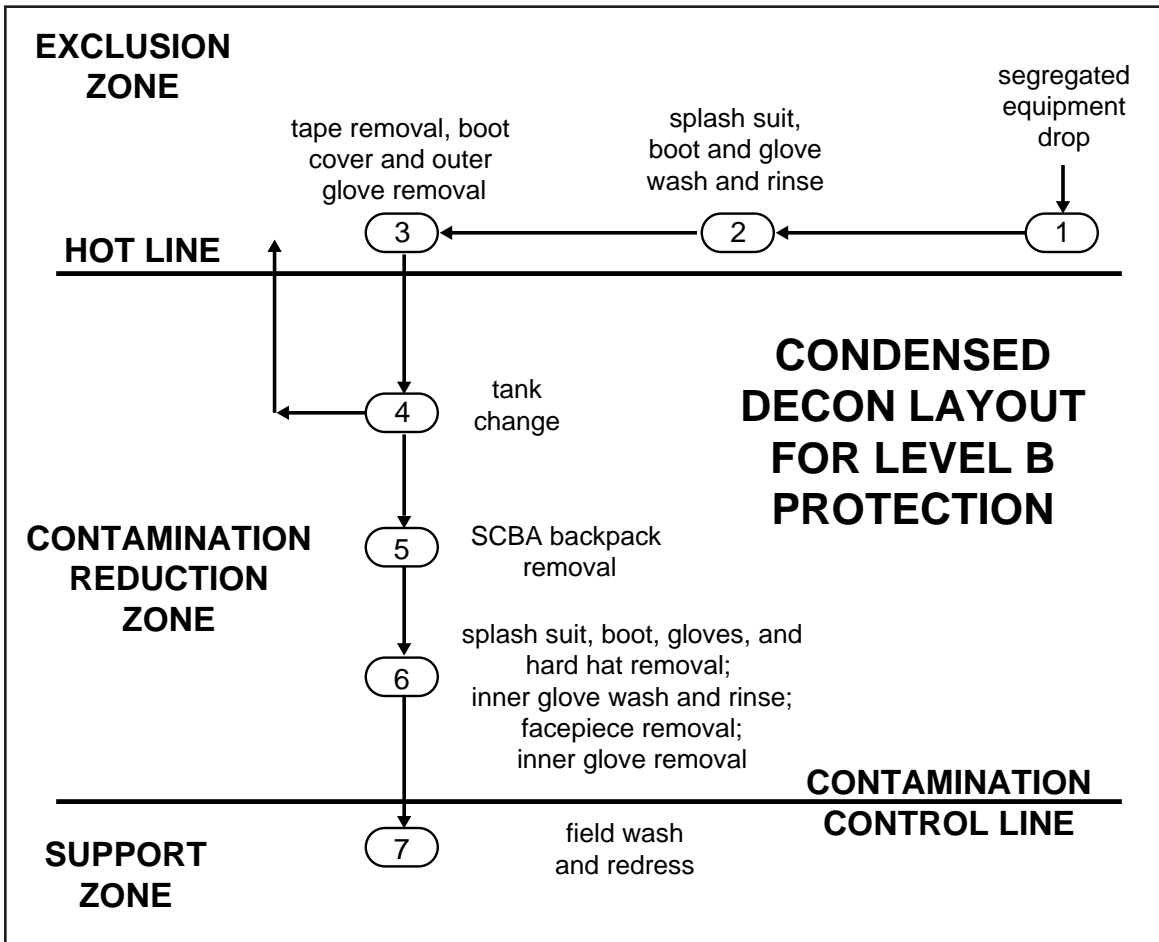
The Contractor will provide and maintain the following facilities for personnel decontamination in the contamination zone. (The decontamination layouts for Protection Levels A, B, and C are shown in Figures 1, 2, and 3.) The following stations will be maintained:

- Station 1** Segregated equipment drop equipped with plastic drop cloths for deposit of hand carried equipment.
- Station 2** Suit and safety boot, boot cover, and outer glove wash and rinse equipped with two No. 3 wash tubs for washing boots, suits, and gloves; decon solution or detergent; and water.



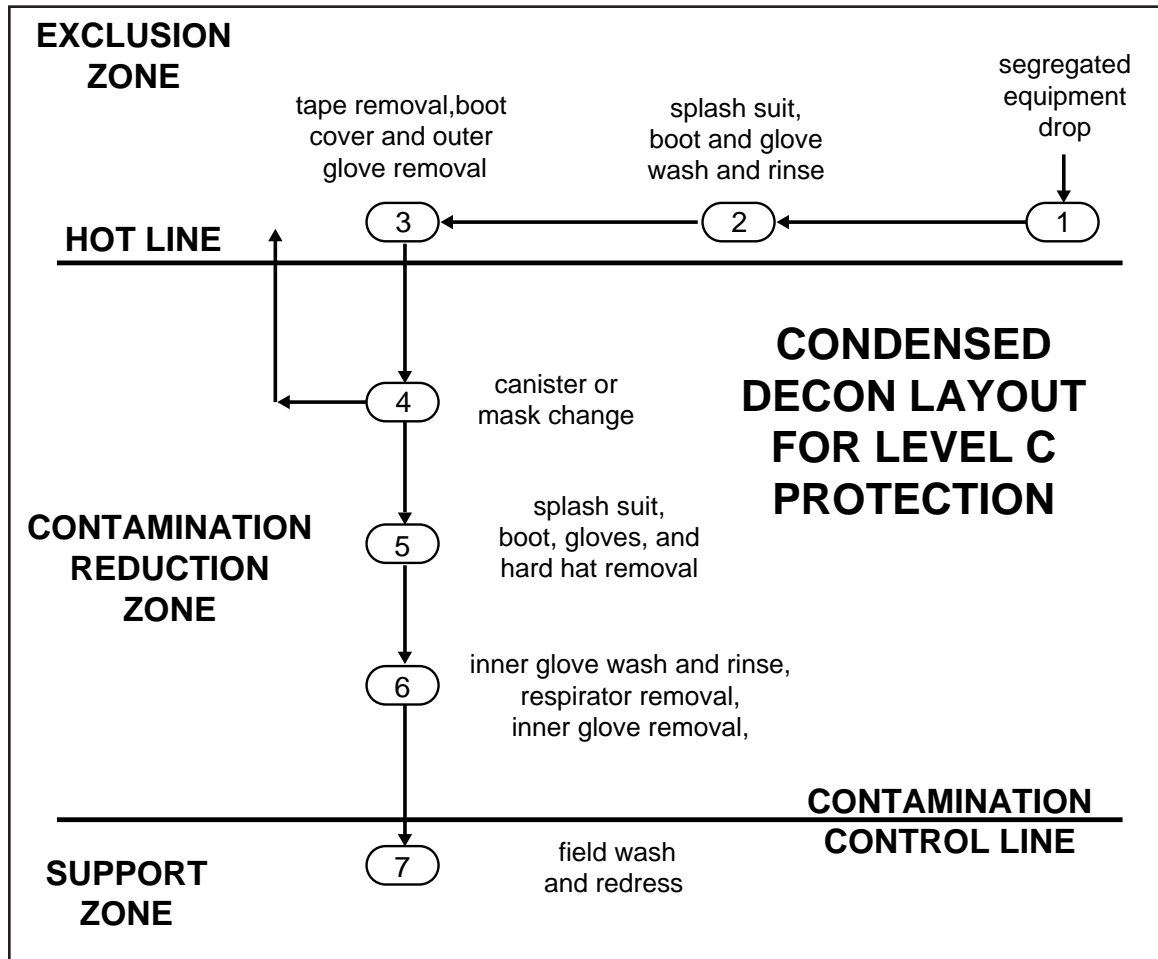
**Figure 1.** Level A condensed decon layout.

- 
- Station 3** Tape removal, boot cover removal, and outer glove removal equipped with 20-gallon container with a plastic liner.
- Station 4** Tank change equipped with replacement air cylinders, boot covers and outer gloves.
- Station 5** Safety boot, fully encapsulating suit and hard hat removal equipped with 30-50-gallon lined container and bench or stool and a drop cloth.
- Station 6** SCBA backpack removal. Inner glove wash and rinse, facepiece removal, and inner glove removal. Equipment at this station includes a table.
- Station 7** Inner clothing removal, field wash, and redress. This station is equipped with a shower, small table, basins or buckets, water, soap, towels, decon or detergent solution, and water basin or bucket.



**Figure 2.** Level B condensed decon layout.

Level B condensed decontamination procedures are very similar to Level A condensed decontamination procedures. The only difference is the removal of the SCBA prior to the protective suit.



**Figure 3.** Level C condensed decon layout.

Level C condensed decontamination procedures are used for a splash suit and canister-equipped, full-face respirator. The process is similar to the level A and B procedures except for the obvious changes because of different respiratory protection. Station 6 switches from tank change to canister or mask change and the SCBA backpack removal station is deleted.

### 11.3 *Clothing*

The Contractor shall provide all required safety clothing. Safety clothes shall be left in the change facility. No safety clothing (including boots) shall be worn or carried out of the project area unless properly decontaminated. Soiled safety clothes shall be disposed of as appropriate.

### 11.4 *Respirators*

All required respirators will be provided and maintained by the Contractor and will be cleaned daily. Cleaning and maintenance will be accomplished in accordance with the appropriate OSHA standards (29 CFR 1910.134).

### 11.5 *Packaging of Waste Items*

All disposable clothing and other contaminated material will be placed in containers for storage on-site. Personnel will make a conscious effort to minimize the volume of contaminated materials. Legible and understandable precautionary labels will be affixed prominently to containers of contaminated scrap, waste, debris, and clothing. Containers will be disposed of with other solids in the approved RCRA landfill.

### 11.6 *Change, Shower, Lunch, and Break Facilities*

Change, shower, lunch, and break facilities will be provided by the Contractor. All personnel must enter and leave the work site through the facility. The Contractor will provide toilets in the shower and change facility and additional units elsewhere on the Site.

### 11.7 *Equipment Decontamination Procedures*

Decontamination of equipment is essential to avoid spread of contamination to clean areas.

Key elements in decontamination are inspection and washing. The latter may require high pressure detergent solution application depending on the level of soil attachment. (Frequency of lubrication may therefore also be affected). Since wash water is then contaminated, a collection system is required.

### 11.8 *Equipment Decontamination Facilities*

Any items taken into the Exclusion Zone will be assumed to be contaminated before they leave the Exclusion Zone. In general, vehicles, equipment, and materials brought into the Exclusion Zone will remain in the Exclusion Zone until no longer necessary to the project.

All contaminated vehicles and equipment will be decontaminated before they are taken off-site. Verification of decontamination will be made by wipe test(s). The Contractor will set up controls to assure that contaminated items do not leave the Exclusion Zone.

The Contractor will provide and maintain the following facilities for equipment decontamination:

- Equipment decontamination pad
- Contaminated water collection system.
- High pressure water or steam cleaners
- Degreasers
- Tri-sodium phosphate (TSP) detergent
- Wire brushes and scrapers

## **12.0 SITE STANDARD OPERATING PROCEDURES**

### **12.1 *Work Practices***

Workers will be expected to adhere to the established safety practices for their respective specialties (e.g., drum handling, sampling, laboratory analysis, construction). The need to exercise caution in the performance of specific work tasks is made more acute due to weather conditions, restricted mobility, and reduced peripheral vision caused by the protective gear itself; the need to maintain the integrity of the protective gear; and the increased difficulty in communicating caused by respirators. Work at the Site will be conducted according to established procedures and guidelines for the safety and health of all involved. Among the most important of these principles for working at the Site are:

- In any unknown situation, always assume the worst conditions and plan responses accordingly.
- Employ the buddy system. Establish and maintain communication.
- Minimize contact with excavated or contaminated materials. Plan work areas, decontamination areas, and procedures to accomplish this. Do not place equipment on drums or on the ground. Do not sit on drums or other materials.
- Use disposable items when possible to minimize risks during decontamination and possible cross-contamination during sampling-handling. This will require a common-sense approach to potential risks and costs.
- Smoking, eating, or drinking after entering the work zone and before decontamination will not be allowed. Ingestion of contaminants is probably the second most likely means of introduction of the toxic substances into the body (inhalation being first).
- Avoid heat and other work stresses related to wearing PPE. Work breaks should be planned to prevent stress-related accidents or fatigue.
- Maintain monitoring systems. Conditions can change quickly if sub-surface areas of contamination are penetrated.

- Be observant of not only one's own immediate surrounding but also that of others. Everyone will be working under constraints to awareness, and it is a team effort to notice and warn of impending dangerous situations. Extra precautions are necessary when working near heavy equipment while using PPE. Vision, hearing, and communication are restricted by the protective gear.
- Use of contact lenses will not be allowed on-site. These prevent proper flushing should corrosive or other substances enter the eyes.
- Site operations requiring Level C protection will require the removal of facial hair (except mustaches) to allow a proper facepiece fit.
- Withdrawal from a hazardous situation to reassess procedures is the preferred course of action.
- Be aware that chemical contaminants may aggravate or worsen symptoms of other illnesses or intoxication. Avoid excess use of alcohol and working when ill.

### *12.2 General Site Safety Rules*

- There will be an informal safety meeting each morning before commencing operations.
- The project Site is divided into an EXCLUSION ZONE (Work Area) and a SUPPORT ZONE (Administrative Area) separated by a CONTAMINATION REDUCTION ZONE (Personnel and Equipment Decontamination Facilities). Entrance to and exit from the EXCLUSION ZONE will be via the CONTAMINATION REDUCTION ZONE. Only authorized and properly protected personnel will be allowed to enter the work area.
- All personnel and equipment must be decontaminated when passing from the EXCLUSION ZONE to the SUPPORT ZONE. Prior to departing from the Site, or at the end of the work day, all personnel will proceed through the Decontamination Station where disposable clothing and equipment will be removed.
- No eating, drinking, smoking, or chewing will be permitted in the EXCLUSION ZONE.
- Prior to eating, drinking, or smoking, all personnel must wash their hands and faces.
- All questions should be referred to the S&HO.
- All personnel will be required to clean their respirators at the end of the work day.
- Violation of these rules will result in immediate dismissal from the Site.

### 12.3 *Communication Procedures*

Personnel in the Exclusion Zone will remain in constant radio communication or within sight of other project personnel. Any failure of radio communication requires an evaluation of whether personnel should leave the Exclusion Zone. A channel will be designated as the radio frequency for personnel in the Exclusion Zone.

A horn blast is the emergency signal to indicate that all personnel should leave the Exclusion Zone. In addition, a loud hailer will be available. The following standard hand signals will be used in case of failure of radio communications:

- Hand gripping throat – Out of air, cannot breathe
- Grip partner's wrist or both hands around waist – Leave area immediately
- Rotating both hands above the head – Need assistance
- Right hand thumb's up – OK, I am alright, I understand
- Right hand thumb's down – No, negative

## 13.0 **MONITORING PROGRAMS**

### 13.1 *Air Monitoring*

A comprehensive air-monitoring program which provides both baseline and on-going air quality data, has been developed and implemented. The instrumentation that will be used on site is:

- Oxygen and combustible gas indicator - MSA Model 261 oxygen and combustible gas indicator.
- Organic vapors and gas detection - The National Draeger or MSA Kwik Draw bellows pump will be used with the appropriate testing tube to detect (and give direct readings of) the presence of organic vapors and gases.
- The MSA Passport 5-Star Multigas Detector or HNu Photoionizer P1101 (trace gas analyzer) will be used to detect and measure the concentration of organics in the air.

The air monitoring program includes the following:

- A preliminary survey of existing air quality conditions, prior to any materials handling and, if possible, under anticipated "worst case" weather conditions (hot, dry, and stagnant), to be used to establish baseline levels for input into the respiratory protection selection process.
- An on-going evaluation of on-site atmospheric contaminant concentrations during site remediation activities.
- Perimeter monitoring of off-site downwind air quality conditions during site operations.

### 13.2 *Personal Monitoring*

Representative personnel exposure monitoring, to determine 8-hour time weighted average (TWA) exposure concentrations, shall be conducted by the S&HO or his designee. Sampling methods, analytical procedures, and sampling frequencies shall be consistent with OSHA and NIOSH requirements and establish the Contractor's policies and procedures.

The S&HO shall compare the monitoring results on a regular basis with the applicable standards to insure that the selected level of protection is appropriate.

### 13.3 *Self Monitoring*

While at the Site, the Contractor's employees will be required to monitor their own health and that of their co-workers for symptoms of toxic exposure. Symptoms include:

- Behavioral changes
- Loss of sensation
- Loss of coordination
- Increased salivation
- Gum and lip discoloration
- Slurred speech
- Skin rashes
- Pupil dilation
- Weight loss
- Change in appetite

Any abnormalities or changes are to be reported and investigated. Symptoms must not be allowed to linger without medical attention. In addition, all accidents and injuries, no matter how small or seemingly insignificant, are to be reported and investigated.

## 14.0 **EMERGENCY RESPONSE PLAN**

### 14.1 *General*

A comprehensive emergency response plan has been developed to handle all on-site emergencies. In the event of an emergency situation (e.g. fire, explosion, significant release of toxic gas, or severe contamination of worker(s), etc.) a continuous blast (1 minute) on an air horn will be sounded from the Command Post. The signal may be repeated at five minute intervals until the S&HO is assured that all site personnel recognize the initiation of the emergency plan.

A list of site conditions that might require implementation of the plan, includes but is not limited to:

- Fire or explosion on site.
- Serious employee injury.
- Accumulation of combustible gases or vapors at concentrations greater than the background concentrations in normal ambient air.
- Oxygen concentration below 19.5%.

- Unsafe working conditions, such as inclement weather or hazardous material releases.
- Major release of toxic materials for which appropriate PPE is not being worn by workers.

Upon hearing the emergency signal all personnel on site shall promptly proceed to the nearest assembly point, normally the entrance to the decontamination line, where the evacuation alarm is subsequently sounded.

#### 14.2 *Evacuation Plan*

All site personnel will be evacuated from the Exclusion and Contamination Reduction Zones if the Emergency Coordinator decides that the workers' personal safety is in danger. If evacuation is necessary, personnel will be notified by a series of short blasts on the air horn for a period of one minute. The following procedures will apply:

- Evacuation will take place through the normal Contamination Reduction Corridor and the normal decontamination procedures will be followed.
- In the event that use of the normal Contamination Reduction Corridor is deemed unsafe, evacuation will be through the Emergency Exit (located at the vehicle decontamination area). Decontamination team personnel will proceed to the alternate exit immediately upon being advised by the Emergency Coordinator.
- Immediately upon completion of the decontamination procedure, personnel will proceed to the Assembly Area adjacent to the Command Post.
- Personnel not requiring decontamination (those outside the CRZ) will proceed immediately to the Assembly Area.
- Upon arriving at the Assembly Area personnel must check in with the checkpoint control person.
- First-Aid Technicians and Fire Brigade Personnel, upon arriving at the Assembly Area, must identify themselves to the Emergency Coordinator.
- The buddy system should be followed throughout the evacuation procedure.

#### 14.3 *Specific Situations*

The following procedures are to be followed for the specific situations listed below which do not require immediate evacuation.

##### 14.3.1 Personnel Injury in the Exclusion Zone

Upon notification of an injury in the Exclusion Zone, the designated emergency signal (continuous horn blast) shall be sounded. All Site Personnel shall assemble at the decontamination line. The rescue team will enter the Exclusion Zone (if required) to remove the injured person to the hotline. The Site S&HO will evaluate the nature of

the injury, and the affected person will be decontaminated to the extent possible prior to movement to the Support Zone. The appropriate first aid shall be administered and a request will be made to the designated medical facility for an ambulance (if required). No persons shall re-enter the Exclusion Zone until the cause of the injury or symptoms is determined.

#### 14.3.2 Personnel Injury in the Support Zone

Upon notification of an injury in the Support Zone, the Site S&HO will assess the nature of the injury. If the cause of the injury or loss of manpower does not affect the performance of site personnel, operations may continue, with the appropriate first aid and necessary follow-up as stated above. If the injury increases the risk to others, the designated emergency signal (continuous horn blast) shall be sounded and all site personnel shall move to the decontamination line for further instructions. Activities on-site will stop until the added risk is removed or minimized.

#### 14.3.3 Fire/Explosion

Upon notification of a fire or explosion on-site, the designated emergency signal (continuous horn blast) shall be sounded and all Site personnel shall assemble at the decontamination line. The fire department shall be alerted and all personnel moved a safe distance from the involved area.

#### 14.3.4 Personal Protective Equipment Failure

If any Site worker experiences a failure or alteration of PPE that affects the protection factor, that person and his/her buddy shall immediately leave the Exclusion Zone. Re-entry shall not be permitted until the equipment has been repaired or replaced.

### 14.4 Responsibilities

The site emergency coordinator is \_\_\_\_\_, the S&HO.  
His/her alternate, or backup is \_\_\_\_\_, the Site Project Manager. The emergency coordinator is responsible for:

- Assessing the situation and determining whether an emergency that requires activating the plan exists.
- Directing all efforts in the area including evacuating personnel and minimizing property loss.
- Ensuring that outside emergency services such as fire departments, police, ambulance, and hospitals are notified when necessary.
- Directing the shutdown of site operations when necessary.
- Notifying regulatory agencies as necessary.

The contact list of key off-site response personnel, agencies, and response groups is on page 6-60.

#### 14.5 *On-Site Emergency Facilities*

The following emergency equipment is available on the Site. Locations are shown on the Site map posted at the Command Post.

- First-aid kit and reference manual
- Dry chemical fire extinguishers
- Fire hose and water supply
- Stretcher
- SCBAs
- Alert air horns
- Blankets
- Eye wash stations
- Safety showers

**EMERGENCY CONTACT LIST****Emergency Contact****Phone Number****Contractor**

Project Manager \_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

S&amp;HO \_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

**Police**

\_\_\_\_\_ State police ( \_\_\_\_ ) \_\_\_\_\_

\_\_\_\_\_ Town police ( \_\_\_\_ ) \_\_\_\_\_

**Hospital**

\_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

\_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

**Fire**

\_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

\_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

**Doctor**

\_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

\_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

**Ambulance**

\_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

\_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

**Life flight helicopter**

\_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

EPA - Region # \_\_\_\_\_

\_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

\_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

EPA - State

\_\_\_\_\_ ( \_\_\_\_ ) \_\_\_\_\_

Directions to the nearest hospital: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

See the site map and the map of \_\_\_\_\_ for further information (Attachments F/G).

#### 14.6 On-Site Emergency Personnel

The following personnel have been trained in specific fields of emergency response and are present on the site during the normal working day:

- First-Aid Technicians:

Title:

\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

- Fire Brigade

Leader:

\_\_\_\_\_

Members:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

#### 14.7 Special Procedures

In the event personnel become contaminated in the emergency incident or are injured while contaminated and require medical treatment, specific emergency decontamination procedures, including instructions for ambulance crews and hospital personnel, are available in the Command Post.

### 15.0 SPILL CONTAINMENT PROGRAM

During operations on the Site, the potential for spills of hazardous material will always exist. By following appropriate work practices this potential can be minimized. The following procedures will be employed to minimize the risk of a release.

- All drums showing any signs of leakage or deterioration will be placed in overpack containers immediately.
- All drums or other containers that hold hazardous materials will be promptly moved to the appropriate staging area. All staging areas will consist of a bermed area lined with plastic (polyethylene) film.
- When excavating for drums, overpack drums must be available in the immediate area of the excavation.
- Absorbents will be available at several designated locations in the exclusion zone.

In the event of a hazardous substance release, such as spilling from a container (drum, tank, tank truck, above ground impoundment, etc.), the following spill containment plan will be implemented to contain and control the spilled material.

1. The employee observing or discovering the spill will notify all on-site personnel by any or all of the following methods.
  - Radio
  - Horn
  - Hand signals
2. The Site Project Manager or his/her alternate (the Safety and Health Officer) will direct on-site activities to contain and control the spill. Any or all of the following methods may be employed depending on the nature, location, and extent of the spill.
  - Use of heavy equipment to cover and berm the spill
  - Pumping out contained liquids from the bermed area
  - Use of absorbents to soak up liquids
  - Use of solidification agents to contain the spread of the liquids and to suppress vapor release
  - Use of foam type agents to suppress vapors thereby reducing fire and inhalation hazards
3. Evacuation and rescue will be carried out in the manner outlined in the Emergency Response Plan (Section 14.0).
4. The following heavy equipment will be available for use in spill containment:
  - Rubber tire loader
  - All terrain forklift
  - Intrinsically safe portable pumps
  - Excavator
  - 5 kilowatt generator
5. The following materials and products, which are stored in the emergency supply trailer, will be available for spill containment.
  - Sorbent boom
  - 10 mil thick polyethylene plastic
  - Nonsparking tools
  - Portable foam generator and pails of foaming agents
6. The Site Project Manager will be responsible for notifying the necessary agencies of the spill and filling out and submitting any necessary reports.

## **16.0 CONFINED SPACE ENTRY PROCEDURE**

This procedure applies to all confined space entries for the purposes of testing, inspection, carrying out work, or doing repairs.

The S&HO is responsible for overall administration of the confined space entry program.

### 16.1 Definitions

Authorized attendant - A qualified authorized person designated to act as the safety watch at the entrance to the confined space.

Authorized entrant - An individual approved or assigned by supervision to perform a specified type of duty in the confined space.

Confined space - Enclosures having limited access and egress in which possible dangerous atmospheric contamination is present or may accumulate, or where an oxygen deficiency may occur due to inadequate ventilation. These spaces may include, but are not limited to, storage tanks, tank trucks, process vessels, pits, vats, man-holes, ventilation ducts, and sewers.

Confined space entry permit - An authorization form that must be completed prior to confined space entry.

Entry supervisor - Supervisor responsible for area of confined space.

Extraction device - Equipment necessary to facilitate the removal of an individual where egress is difficult.

Isolation - Positively blocking out or preventing the entry of hazardous materials or the creation of hazardous conditions.

Lower explosive limit - This term is equivalent to LFL.

Lower flammable limit - The lowest concentration at which a chemical can ignite with an ignition source.

Qualified person - A person who by reason of training and experience is familiar with the operation to be performed and the hazards involved.

### 16.2 Training

All employees involved in the performance of confined space operations must be instructed on the hazards involved and procedures required which will include, as a minimum, the following:

- Health and safety hazards
- Lockout/tagout/blockout techniques
- Inerting of the spaces
- Testing of atmosphere and inspection procedures
- Completion of confined space entry permit
- Ventilation techniques
- Standby person duties
- Emergency and contingency procedures

### 16.3 *Pre-entry Procedures*

- a. A qualified and authorized person shall ensure that the confined space will be positively isolated to prevent introduction of hazardous materials. This may include removal of spool pieces or valves, the insertion of blanks, and the closing, locking, and tagging of double block and bleed valves in series.
- b. A qualified and authorized person shall ensure that mechanical or electrical hazards, including ignition sources, in the confined space shall be positively locked out and tagged out. (Includes items such as fans, agitators, and electrical circuits.)
- c. Each individual assigned to enter the confined space shall place his own lock, to which only he has the key, on each item to be locked out.
- d. The immediate area around the confined space shall be inspected by an authorized and qualified person to ensure that no chemical or physical hazards that may have an adverse effect in the confined space exists.
- e. A safety standby person who is a qualified individual must be assigned to the operation.
- f. A constant source of fresh air, introduced in such a manner as to ensure complete air exchange, must be provided for enclosed confined spaces.
- g. Ventilation equipment shall be bonded and grounded prior to operation. The exhaust of the ventilation shall be located downwind and away from exterior personnel and equipment.
- h. Emergency equipment (e.g., emergency eyewash, SCBAs, fire extinguishers) must be on hand and in working condition. The location of emergency phones (and numbers) or communication systems must be documented. The site emergency coordinator must be notified of confined space activity.
- i. All electrical equipment to be used inside a confined space shall be properly grounded and connected via a ground fault circuit interrupter (GFCI). In addition, waterproof fittings may be required. Intrinsically safe or explosion proof equipment, labeled with an Underwriter's Laboratory (UL) or Mine Safety and Health Administration (MSHA) approval, is required in all spaces where the possibility of a flammable hazard exists. Low voltage (24 volt) lanterns should be used in lieu of other lighting systems.
- j. Each person entering a confined space shall wear a rescue harness or wristlets with lifeline attached, as required by the job. Top entry requires an extraction device if feasible.
- k. It will be the primary responsibility of the supervisor initiating the permit to see that all safety conditions and practices continue for the duration of the job.
- l. Prior to entry, the supervisor shall verify that all activities associated with the confined space entry permit are completed.

---

*16.4 Inspection Testing and Entry Permits*

- a. No employee is to enter any confined space without a confined space entry permit having been properly executed by a qualified and authorized person. The permit is good for one time and one place. A new permit shall be completed prior to each shift or after an extended work stoppage (greater than one hour). This includes repeated atmospheric testing and inspections.
- b. The confined space shall be tested for hazardous atmospheric contaminants, which will include as a minimum, flammable vapors (percentage of LEL), oxygen deficiency (percentage of oxygen) and toxic hazards (concentration of any known contaminants). No one may enter the space if the flammable vapor level is 10% or more of the LEL or the oxygen content is less than 19.5%. Readings must be noted on the confined space entry permit. The space should be cleaned from the exterior, purged, or ventilated prior to retesting if levels are exceeded.
- c. Based on the hazard inspection and air testing, the decision to enter is made. The protective and emergency equipment must be available and noted on the confined space entry permit.
- d. No one may enter the confined space until every item on the confined space entry permit is completed and is posted in a location near the entry point. Do not leave blanks. Initial each “yes” or “not necessary” where applicable. All entries must be in ink.
- e. The following signatures are required to be on the confined space entry permit prior to entry:
  - Entrant
  - Attendant
  - Supervisor
- f. At the end of the shift, the confined space entry permit shall be removed from the job site by the supervisor and forwarded to the site safety office for review and filing. The completed permits shall be kept on file for one year.

### 16.5 *Authorized Attendant*

- a. Employees working inside a confined space must be under constant observation of a fully instructed authorized attendant.
- b. Before anyone enters the confined space, the authorized attendant will be instructed by the supervisor in charge of the entry on the following: (A checklist, Attachment B, is provided for this purpose.)
  - A valid confined space entry permit has been executed and posted.
  - Rescue harness and lifelines are available and used.
  - The location of the nearest:
    - Telephone or two-way radio
    - Safety shower
    - Fire extinguisher
  - A description of the location where the entry is taking place.
  - Shut down procedures for welding/burning equipment. As long as anyone is inside the confined space, the authorized attendant must remain in continuous contact with the worker. **HE/SHE IS NOT TO LEAVE THE OBSERVATION POINT, EXCEPT TO REPORT AN EMERGENCY**, after first sounding his/her alarm device.
  - **UNDER NO CIRCUMSTANCES SHOULD THE AUTHORIZED ATTENDANT ENTER THE CONFINED SPACE.** If the worker(s) in the confined space becomes ill or injured, the authorized attendant will sound the alarm and proceed to the nearest telephone or two-way radio. He/She should speak clearly and give the details about what has happened and where the emergency is. He/She is to be sure the message is repeated back correctly before leaving the phone or radio. The authorized attendant still **DOES NOT ENTER THE CONFINED SPACE.** He/she returns to the confined space and directs the rescue team.

## ATTACHMENT A

## CONFINED SPACE ENTRY PERMIT

Location/description of permit space: \_\_\_\_\_

Purpose of entry: \_\_\_\_\_

Entry Authorized: From: \_\_\_\_\_ To: \_\_\_\_\_ Date: \_\_\_\_\_

Current Authorized Entrants:

Name	Time In/Out	Time In/Out	Time In/Out
_____	_____/____	_____/____	_____/____
_____	_____/____	_____/____	_____/____

Current attendant(s): (Name/Time When Duties Assumed and Relinquished)

Authorizing Entry Supervisor: (Name/ Time/ Date)

Current Entry Supervisor: (Name/Time When Duties Assumed and Relinquished)

Known Hazards: \_\_\_\_\_

Pre-Entry Atmospheric Testing:	Reading	Time	Initials
Oxygen Content:	_____	_____	_____
Flammability Level (% LEL):	_____	_____	_____
Toxicity (ppm):	_____	_____	_____

Initial Tests Within Limits? Yes: \_\_\_\_\_ No: \_\_\_\_\_

If no, test and record in remarks section every: \_\_\_\_\_ minutes.

Is there a known presence or potential for the presence of any other toxic hazards or flammables?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

Initial All Items	Yes	Not Necessary
1. Space purged-flushed and vented:	_____	_____
2. Area secured with posts and flags:	_____	_____
3. Lockout/deenergize/tryout:	_____	_____
4. All lines broken and/or blanked:	_____	_____
5. Observer assigned and properly instructed:	_____	_____
6. Employees in the immediate area alerted to help if needed:	_____	_____
7. Ventilation provided:	_____	_____
8. Electrical equipment bonded and grounded:	_____	_____
9. Intrinsically safe equipment required:	_____	_____

Continuos Atmospheric Monitoring: Yes: \_\_\_\_\_ No: \_\_\_\_\_

Periodic Atmospheric Testing: \_\_\_\_\_ Intervals

Oxygen Level: \_\_\_\_\_ % \_\_\_\_\_ Time: \_\_\_\_\_  
SignatureCombustible Gas Level: \_\_\_\_\_ % \_\_\_\_\_ Time: \_\_\_\_\_  
(LEL) SignatureSpecific Air Contaminant: \_\_\_\_\_ Time: \_\_\_\_\_  
(ppm) Signature

Chemical: \_\_\_\_\_

## Required Personal Protective Equipment:

Gloves: \_\_\_\_\_ Splash Suit: \_\_\_\_\_ Boots: \_\_\_\_\_  
 SCBA: \_\_\_\_\_ SAR: \_\_\_\_\_ APR: \_\_\_\_\_  
 Goggles: \_\_\_\_\_ Glasses: \_\_\_\_\_ Face Shield: \_\_\_\_\_  
 Body Harness: \_\_\_\_\_

Individual Responsible for PPE Selection: \_\_\_\_\_ Signature: \_\_\_\_\_

## Communications Equipment/Procedures to be Used:

2-Way Radio: \_\_\_\_\_ Hand Signals: \_\_\_\_\_ Alarm: \_\_\_\_\_  
 Radio Channel to Use: \_\_\_\_\_ Mobile Phone: \_\_\_\_\_ Batteries in Good Condition: \_\_\_\_\_

Special Tools and Equipment - Including Lighting Equipment: \_\_\_\_\_

All Tools and Equipment are Safe for the Environment Being Used In, i.e. Water-Tight and Spark-Proof:

All Power Cords Have Been Visually Inspected: Yes: \_\_\_\_\_ No: \_\_\_\_\_  
 Batteries in Good Condition: Yes: \_\_\_\_\_ No: \_\_\_\_\_

## Emergency Rescue Procedures:

Location of Written Emergency Response Plan: \_\_\_\_\_  
 Type of Emergencies/Rescue Team Required: On-Site: \_\_\_\_\_ Off-Site: \_\_\_\_\_

## Emergency Rescue Equipment Available On-Site:

Full Body Harness w/ D-rings: \_\_\_\_\_  
 Lifelines: \_\_\_\_\_ Fire Extinguishers: \_\_\_\_\_  
 Retrieval System: \_\_\_\_\_ Evacuation Alarm: \_\_\_\_\_  
 PPE: \_\_\_\_\_  
 SCBAs: \_\_\_\_\_  
 Explosion Proof Emergency Lighting: \_\_\_\_\_  
 Powered Communication Equipment Available/Tested: \_\_\_\_\_

Off-Site Rescue Service Procedures: \_\_\_\_\_  
 Name of Rescue Service: \_\_\_\_\_  
 Phone Number: \_\_\_\_\_

## Rescue Team Notified of Location, Potential Hazards, and Route to Site:

Yes: \_\_\_\_\_ No: \_\_\_\_\_  
 Does the rescue service have the necessary rescue equipment to meet the site's needs:  
 Yes: \_\_\_\_\_ No: \_\_\_\_\_

**Authorization:** All actions/conditions necessary for safe entry into, working in, and exiting from the confined space have been performed. Entry is permitted on the date and time, and for the duration, specified above.

\_\_\_\_\_  
 (Signature of Authorizing Entry Supervisor)

**Cancellation:** All entrants have exited the confined space and this permit is canceled.

\_\_\_\_\_  
 (Time) (Signature of Authorizing Entry Supervisor)

Describe problems encountered during entry: \_\_\_\_\_

Hot Work [may] / [shall not] be conducted in this permit-required confined space.

Hot Work Permit Issued: \_\_\_\_\_ Additional Controls: \_\_\_\_\_  
 Other Permits Issued: \_\_\_\_\_ Specify: \_\_\_\_\_

Additional Precautionary Remarks: \_\_\_\_\_

---

**ATTACHMENT B****AUTHORIZED ATTENDANT'S CHECKLIST**

- |     |   |     |
|-----|---|-----|
| 1.  | Valid confined space entry permit.  | [ ] |
| 2.  | Harness and life line used.   | [ ] |
| 3.  | Instructed in the use of life line and harness.                                     | [ ] |
| 4.  | Knows location of telephone or two-way radio.                                       | [ ] |
| 5.  | Knows how to report emergency.  | [ ] |
| 6.  | Knows location of job site and report.  | [ ] |
| 7.  | Knows not to leave site when employee(s) are inside, except to make emergency call. | [ ] |
| 8.  | Knows NOT TO ENTER CONFINED SPACE.  | [ ] |
| 9.  | Knows location of safety shower.  | [ ] |
| 10. | Knows location of fire extinguisher and how to use it.                              | [ ] |
| 11. | Understands operation of blower or other air source.                                | [ ] |
| 12. | Knows the operation of respirators (air line and SCBAs).                            | [ ] |
| 13. | Has all necessary equipment including alarm horn.                                   | [ ] |
| 14. | Knows how to shut off welding/burning equipment.                                    | [ ] |
| 15. | Hazards of job and methods to safely perform work explained.                        | [ ] |
| 16. | Establish and maintain clear access to and from the space.                          | [ ] |

**ATTACHMENT C****COMPLIANCE AGREEMENT**

Safety and Health Plan Compliance Agreement

\_\_\_\_\_ Mock Site - Remedial Project

I, \_\_\_\_\_ (print name), have received a copy of the Safety and Health Plan for the \_\_\_\_\_ Mock Site. I have read the plan, understood it, and agreed to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the safety requirements specified in the plan.

Signed:

\_\_\_\_\_  
Signature\_\_\_\_\_  
Date

Signed for:

\_\_\_\_\_

Construction Company:

\_\_\_\_\_  
Signature\_\_\_\_\_  
Date

**ATTACHMENT D**  
**HAZARDOUS SUBSTANCE INFORMATION FORM 1**

COMMON NAME: Cutting Oil

CHEMICAL NAME: Amino-cut

## I. PHYSICAL/CHEMICAL PROPERTIES

Natural physical state: \_\_\_ Gas yes Liquid \_\_\_ Solid  
(at temps. of 20°C-25°C)

**Source**  
CHEM. DIC

Molecular weight: 93 g/g-mole

CHEM DIC

Density: g/ml

CHEM DIC

Specific gravity: 1.02 @ 90 °F/°C

CHEM DIC

Solubility in water: °F/°C

CHEM DIC

Solubility: °F/°C

CHEM DIC

Boiling point: 184 °F/°C

CHEM DIC

Melting point: -6 °F/°C

CHEM DIC

Vapor pressure: 1.0 mmhg@ 34 °F/°C

CHEM DIC

Vapor density: 3.22 @ 70 °F/°C

CHEM DIC

Flash point: open closed 70 °F/C

CHEM DIC

Other:

## II. HAZARDOUS CHARACTERISTICS

Toxicological	Hazard	Concentrations	Source
---------------	--------	----------------	--------

Inhalation:	<b><u>Yes</u></b>	No	PEL 2 ppm	OSHA
-------------	-------------------	----	-----------	------

Ingestion:	Yes	No	ACGIH
------------	-----	----	-------

Skin/eye absorption:	<b><u>Yes</u></b>	No	TWA 5 ppm	ACGIH
----------------------	-------------------	----	-----------	-------

Skin/eye contact:	<u>Yes</u>	No	ACGIH
-------------------	------------	----	-------

Carcinogenic:	Yes	<b>No</b>
---------------	-----	-----------

Teratogenic:	Yes	<b>No</b>
--------------	-----	-----------

Mutagenic:	Yes	<b>No</b>
------------	-----	-----------

Aquatic: Yes No

Other:	Yes	<u>No</u>	LC 50 1-50 mg
--------	-----	-----------	---------------

Combustibility: Yes **No**

Toxic by-product(s):                      **Yes**      No

Flammability:	Yes	No
---------------	-----	----

LFL	1.3 %
-----	-------

UFL	11.0 %
-----	--------

Reactive/Corrosive	Hazard	Concentrations	Source
Reactivity: <u>water, bases, metals</u>	Yes <b><u>No</u></b>		
Corrosiveness:	Yes <b><u>No</u></b>		
pH: _____	Yes No		
Neutralizing agent: _____ _____	Yes No		

Radioactive	Hazard	Exposure Rate	Source
Background:	Yes <b><u>No</u></b>		
Alpha particles:	Yes <b><u>No</u></b>		
Beta particles:	Yes <b><u>No</u></b>		
Gamma radiation:	Yes <b><u>No</u></b>		

### III. DESCRIPTION OF INCIDENT

Quantity involved: \_\_\_\_\_  
 Release Information: \_\_\_\_\_  
 Monitoring/sampling: \_\_\_\_\_

### IV. RECOMMENDED PROTECTION

Worker: Chemical resistant splash suit, supplied air respirator, gloves and boots.  
 Level B protection  
 Public:

### V. RECOMMENDED SITE CONTROL

Hotline: \_\_\_\_\_  
 Decon line: \_\_\_\_\_  
 Command post: \_\_\_\_\_

### VI. REFERENCES FOR SOURCES

ACGIH	American Conference of Governmental Industrial Hygienists
CHRIS	Chemical Hazards Response System Manual II
CHEM DIC.	Condensed Chemical Dictionary - Tenth Ed, 1981
OSHA	29 CFR Part 1910.1017

**HAZARDOUS SUBSTANCE INFORMATION FORM 2**

COMMON NAME: Fecolic Acid

CHEMICAL NAME: Fecolic Acid

**I. PHYSICAL/CHEMICAL PROPERTIES****Source**

Natural physical state: \_\_\_ Gas    yes Liquid    \_\_\_ Solid  
(at temps. of 20°C-25°C)

Molecular weight: 34 g/g-mole

Density: 102 g/ml

Specific gravity: 1.3 °F/°C

Solubility in water: 100% °F/°C

Solubility: °F/°C

Boiling point: 258/126 °F/°C

Melting point: -40 °F/°C

Vapor pressure: 8 mmhg@ 25 °F/°C

Vapor density: 1.02 °F/°C

Flash point: open closed will not burn °F/°C

Other: Odorless, colorless

CHRIS

CHRIS

CHRIS

CHRIS

**II. HAZARDOUS CHARACTERISTICS**

Toxicological	Hazard		Concentrations	Source
Inhalation:	<u>Yes</u>	No	LC 50 2000 ppm	OSHA
Ingestion:	<u>Yes</u>	No	LD 50 75ppm	ACGIH
Skin/eye absorption:	<u>Yes</u>	No	LD 50 700 mg/kg	ACGIH
Skin/eye contact:	Yes	No		ACGIH
Carcinogenic:	Yes	<u>No</u>		
Teratogenic:	Yes	<u>No</u>		
Mutagenic:	Yes	<u>No</u>		
Aquatic:	Yes	<u>No</u>		
Other: <u>8 hour TWA</u>	Yes	<u>No</u>	1.0 ppm	ACGIH
Combustibility:	Yes	<u>No</u>		
Toxic by-product(s):	<u>Yes</u>	No		
_____				
_____				

Flammability: Yes No  
LFL  
UFL

Reactive/Corrosive	Hazard	Concentrations	Source
Reactivity: <u>powerful oxidizer</u>	<b>Yes</b> No		
corrosiveness:	Yes <b>No</b>		
pH: _____	Yes No		
Neutralizing agent:	Yes No		
_____			
_____			

Radioactive	Hazard	Exposure Rate	Source
Background:	Yes <b>No</b>		
Alpha particles:	Yes <b>No</b>		
Beta particles:	Yes <b>No</b>		
Gamma radiation:	Yes <b>No</b>		

### III. DESCRIPTION OF INCIDENT

Quantity involved: \_\_\_\_\_  
 Release Information: \_\_\_\_\_  
 Monitoring/sampling: \_\_\_\_\_

### IV. RECOMMENDED PROTECTION

Worker: Chemical resistant splash suit, supplied air respirator, boots, and gloves.  
 Level B protection.  
 Public:

### V. RECOMMENDED SITE CONTROL

Hotline: \_\_\_\_\_  
 Decon line: \_\_\_\_\_  
 Command post: \_\_\_\_\_

### VI. REFERENCES FOR SOURCES

ACGIH	American Conference of Governmental Industrial Hygienists
CHRIS	Chemical Hazards Response System Manual II
CHEM DIC.	Condensed Chemical Dictionary - Tenth Ed, 1981
OSHA	29 CFR Part 1910.1017

## HAZARDOUS SUBSTANCE INFORMATION FORM 3

COMMON NAME: Peroxide

CHEMICAL NAME: Peroxide

## I. PHYSICAL/CHEMICAL PROPERTIES

## Source

Natural physical state: \_\_\_ Gas    yes Liquid    \_\_\_ Solid  
(at temps. of 20°C-25°C)

Molecular weight: g/g-mole

Density: g/ml

Specific gravity: °F/°C

Solubility in water: °F/°C

Solubility: °F/°C

Boiling point: 193 °F/°C

Melting point: -35 °F/°C

Vapor pressure: 0.3 mmhg@ 25 °F/°C

Vapor density: 3.4 @ 25 °F/°C

Flash point: open closed °F/°C

Other: Odorless, colorless

CHRIS

CHRIS

CHRIS

CHRIS

## II. HAZARDOUS CHARACTERISTICS

Toxicological	Hazard		Concentrations	Source
Inhalation:	<u>Yes</u>	No	1 hr. LC 50 347 ppm	OSHA
Ingestion:	<u>Yes</u>	No	LD 50 2140 mg/kg	ACGIH
Skin/eye absorption:	<u>Yes</u>	No	Causes severe burns	ACGIH
Skin/eye contact:	<u>Yes</u>	No	Causes severe burns	ACGIH
Carcinogenic:	Yes	<u>No</u>		
Teratogenic:	Yes	<u>No</u>		
Mutagenic:	Yes	<u>No</u>		
Aquatic:	Yes	<u>No</u>		
Other:	Yes	<u>No</u>		
Combustibility:	Yes	<u>No</u>		
Toxic by-product(s):	<u>Yes</u>	No		
<u>Sulfur dioxide (SO<sub>2</sub>)</u>			at high temps	CHRIS
Flammability:	Yes	<u>No</u>		
LFL				
UFL				

Reactive/Corrosive	Hazard	Concentrations	Source
Reactivity: <u>water, bases, metals</u>	<u>Yes</u> No		CHRIS
corrosiveness:	<u>Yes</u> No	all	CHRIS
pH: _____	Yes No		
Neutralizing agent: _____ _____	Yes No		

Radioactive	Hazard	Exposure Rate	Source
Background:	Yes <u>No</u>		
Alpha particles:	Yes <u>No</u>		
Beta particles:	Yes <u>No</u>		
Gamma radiation:	Yes <u>No</u>		

### III. DESCRIPTION OF INCIDENT

Quantity involved: \_\_\_\_\_  
 Release Information: \_\_\_\_\_  
 Monitoring/sampling: \_\_\_\_\_

### IV. RECOMMENDED PROTECTION

Worker: Chemical resistant splash suit (acid proof), OSHA permissible respiratory protection, splash goggles, gloves, and boots.  
 Public:

### V. RECOMMENDED SITE CONTROL

Hotline: \_\_\_\_\_  
 Decon line: \_\_\_\_\_  
 Command post: \_\_\_\_\_

### VI. REFERENCES FOR SOURCES

ACGIH American Conference of Governmental Industrial Hygienists  
 CHRIS Chemical Hazards Response System Manual II  
 CHEM DIC. Condensed Chemical Dictionary - Tenth Ed, 1981  
 OSHA 29 CFR Part 1910.1017

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**ATTACHMENT E****STANDARD MEDICAL CERTIFICATE**

Company: \_\_\_\_\_

Applicant's Name: \_\_\_\_\_

Social Security #: \_\_\_\_\_

Date: \_\_\_\_\_

The above named applicant was examined by me and has been classified as noted below.

**GRADE**

A \_\_\_\_\_ No significant defects, physically fit for job applied for.

B \_\_\_\_\_ Minor defects not expected to interfere with job performance.

C \_\_\_\_\_ Substantial defects that warrant temporary rejection pending further evaluation or treatment of a condition that should be cleared prior to employment.

D \_\_\_\_\_ Severe defects, major findings that can be expected to interfere with safe job performance and that cannot be corrected. (Applicants in this category cannot be employed without review and approval of the Corporate Medical Director.)

COMMENTS: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Physician's Name: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Physician's Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**ATTACHMENT F****SITE ENTRY - GENERAL STANDARD OPERATING PROCEDURES****Personal Precautions**

1. Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited.
2. Hands and face must be thoroughly washed upon leaving the work area and before eating, drinking, or any other activities.
3. Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.
4. No facial hair that interferes with a satisfactory fit of the mask-to-face seal is allowed on personnel required to wear respiratory protective equipment.
5. Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible don't walk through puddles or mud, or on other discolored surfaces; kneel on the ground; lean, sit, or place equipment on drums, containers, vehicles, or the ground.
6. Medicine and alcohol can worsen effects from exposure to toxic chemicals.
7. Contact lenses cannot be worn with respirators, nor can they be worn in controlled areas.
8. Use the buddy system or maintain radio contact with the office vehicle in controlled areas.

**Safety Plans and Procedures**

1. A Site Safety Plan must be developed for all phases of site operations.
2. All personnel must be familiar with standard operating safety procedures.
3. All personnel going on-site must be adequately trained and thoroughly briefed on anticipated hazards, equipment to be worn, safety practices to be followed, emergency procedures, and communications.
4. Any required respiratory protective devices and clothing must be worn by all personnel going on-site.

**Operations**

1. Entrance and exit must be planned and emergency escape routes delineated.
2. Workers should practice unfamiliar operations prior to the actual procedure.
3. Personnel on-site must use the buddy system when working in contaminated or otherwise hazardous areas.
4. During continual operations, on-site workers act as safety backup to each other, off-site personnel provide emergency assistance.
5. Communications using radios or other means must be maintained between initial entry members at all times.
6. Visual contact must be maintained between buddies and safety personnel.
7. Personnel and equipment in the contaminated area should be minimized.
8. Work areas for various operational activities must be established.
9. Procedures for leaving a contaminated area must be planned and implemented prior to going on site.





# HAZARDOUS WASTE WORKER

Section

**7**

Title

**MATERIAL HANDLING  
AND SAMPLING**

## TRAINEE OBJECTIVES

After completing Section 7, you will be able to:

1. Match the following words with the proper definition or example:  
  
Auger and thin-wall tube sampler  
Bulging drum  
Lab pack  
Overpack  
Thief
2. List the three major categories or types of samples that might be collected.
3. Identify five items that are looked for during the preliminary inspection.
4. Name five indicators of possible contamination.
5. List the actions to take if a contamination source or indicator is found.
6. List the four general rules for staging.

## Standard Operating Procedures

1. Sampling procedures
2. Drum inspection and overpacking
3. Uncovering and staging drums



**INTRODUCTION**

Some of the most frequent and most severe injuries associated with hazardous waste cleanup are those caused by material handling. Injuries result from heavy equipment operation, suspended loads, and mechanical handling devices. However, most injuries are the result of manually lifting and handling awkward or heavy objects. But even lightweight and small objects can injure the body when lifting involves bending, stretching, or moving body parts (fingers, arms, legs, or torso). Strains, sprains, fractures, and bruises are some other common injuries caused by improper lifting, carrying too heavy a load, incorrect gripping, and failing to wear appropriate personal protective equipment (*PPE*).

Handling waste containers can also lead to accidents and chemical exposures. Whenever practical, containers containing unknown or unidentified waste should always be handled using mechanical devices. When manual handling is required, always use proper work practices, maintain a safe distance from other workers and hazard areas, and minimize handling of unknown materials until they can be identified.

Workers must be properly trained and physically qualified, by medical examination if necessary, for any work assignment that involves lifting heavy objects. Materials likely to be handled during the clean-up process include:

- Containers (bottles, bags, fiber packs, cylinders, tanks, drums, etc.)
- Equipment (machines and tools)
- Solid waste (debris, building materials, soil, etc.)
- Liquid waste

**HANDLING  
HAZARDOUS  
MATERIALS**

Hazardous waste containers can be found throughout a hazardous waste site. They may be stacked on pallets, in piles, buried, or just randomly scattered around the site. Handling hazardous materials and hazardous waste requires extra precautions because of the hazards associated with these materials.

The clean-up process involves handling these materials during the following activities:

- Locating and identifying both loose contamination and waste containers
- Organizing hazardous waste for treatment or storage
- Preparing for disposal or transport

Because of the hazards associated with bulk containers, these materials are given priority with regards to clean-up. The Resource Conservation and Recovery Act (*RCRA*) regulations cover treatment, storage, and disposal of hazardous wastes and the Department of Transportation (*DOT*) regulations cover the shipment of these materials.

Figure 7-1 shows the typical steps that may be carried out at a waste site where materials are handled for disposal as part of the site cleanup.

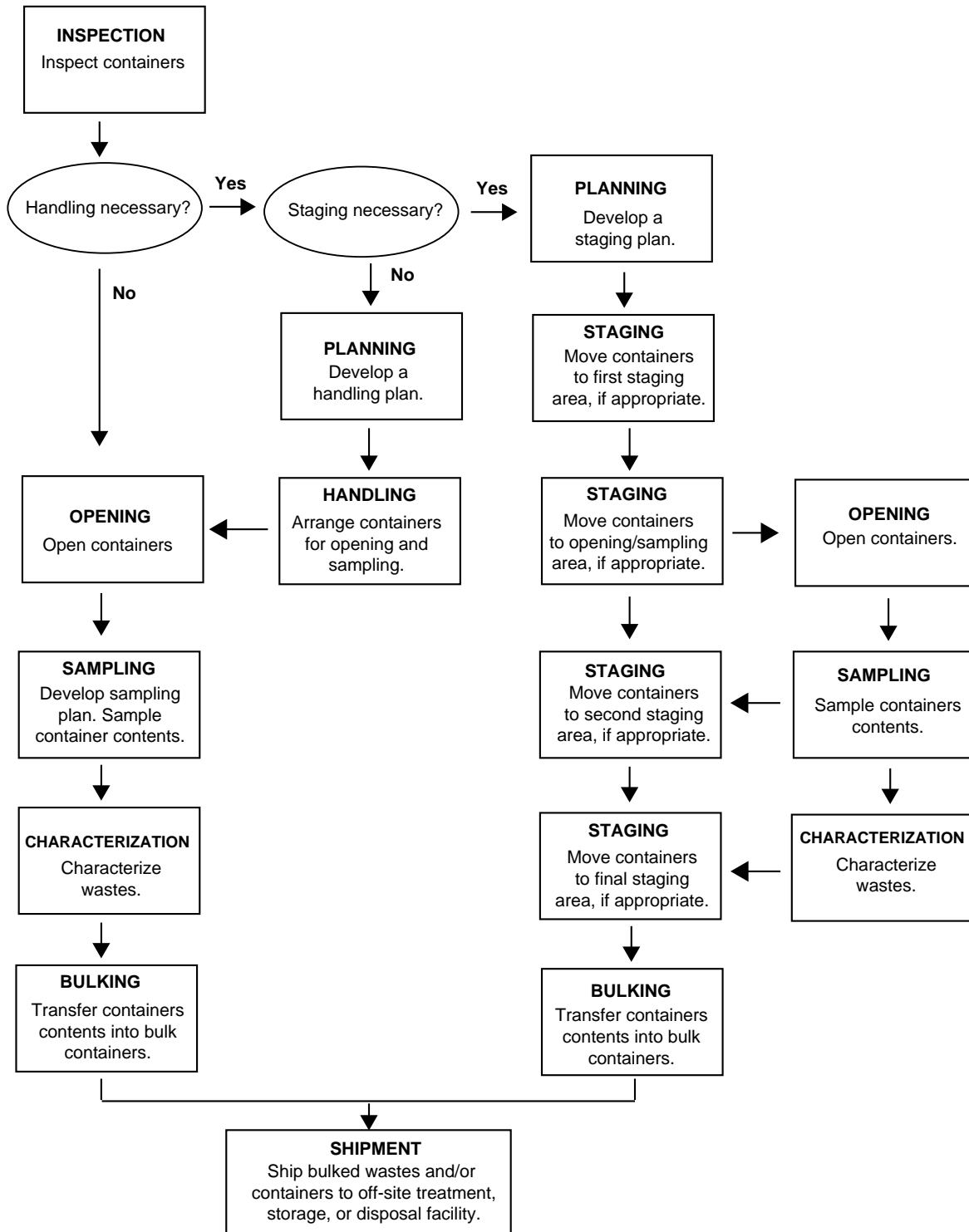
Hazardous materials can be moved either manually or with mechanical devices such as front end loaders or cranes equipped with special attachments.

### **Mechanical Devices**

Mechanical devices should always be used for lifting, moving, and opening waste containers whose contents are questionable or known to be unstable. They should also be used for lifting and moving objects that are too heavy or bulky for manual handling. Common mechanical material handling equipment includes:

- Forklifts
- Cranes and hoists
- Backhoe, front end loader

Only workers who have been properly trained should be permitted to operate such devices. Heavy objects that require special handling or rigging must be moved only by certified riggers or under the guidance of a worker specifically trained to move heavy objects.



**Figure 7-1.** Material Handling flow chart

### Rough Terrain Forklifts

A rough terrain forklift is specifically designed for use on unpaved surfaces. It is one of the most commonly used and widely accepted means for moving large amounts of materials. To operate a forklift, workers must be qualified, authorized operators and knowledgeable on the safety rules and regulations for the job site. General safety guidelines to follow when operating any forklift include:

- Read the site safety and health plan and site-specific work documents to obtain information about PPE, site conditions, and safety and health information.
- Know the capacity and operating characteristics of the forklift.
- Drive forklifts forward when going up an incline and backward when going down.
- Do not allow anyone to walk under a raised load. Assign a watch person or rope off the area if necessary.
- Do not carry passengers on lifting equipment unless it is specifically equipped for that purpose.
- Ensure there is a clear view of the roadway when carrying containers.
- Use caution when handling containers, to avoid heavy equipment running over supplied air lines or air monitoring equipment.

### *Attachments*

Forklifts can be modified with attachments to perform specialized functions and operations. Two common attachments are work platforms and drum grapples. Work platforms give workers access to areas that would normally be difficult to reach or dangerous. A *drum grapple* is a device that allows remote drum handling.

Grapplers keep operators a distance away from the drums so there is less chance of injury if a drum explodes or ruptures. If a drum is leaking, the operator can stop the leak by rotating the drum and immediately placing it into an overpack. In case of an explosion, grapple claws help protect the operator by partially deflecting the force of the explosion.

**Inspection**

All mechanical lifting and moving devices must be inspected periodically and repaired when necessary. Under no circumstances shall defective equipment be used. As a safety precaution, check for faulty or defective parts before lifting a load that is near the load capacity of the equipment. Tags must clearly state the rated load capacity on all lifting devices, and capacities must **never** be exceeded.

**Manual Handling**

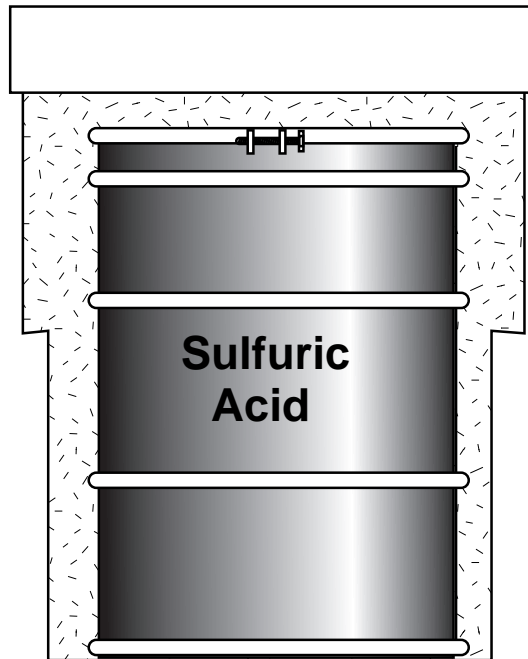
When manually lifting and handling material, use only those methods that ensure worker safety and avoid damaging material or equipment being handled. Never attempt to lift objects that are either too heavy or bulky to handle safely. Whenever possible, push rather than pull loads. Pushing uses the strong leg muscles, whereas pulling uses the easily strained back muscles.

An accident is most likely to occur when containers are handled, particularly for the first time. Therefore, good work practices are important, such as:

- Before handling any container, workers should be warned about the hazards and told to avoid unnecessary handling.
- Workers should stay alert, and find out about possible new hazards as they do the job.
- There should be a supply of storage containers or overpack drums and absorbent material to soak up spills. Overpack drums are larger drums into which leaking or damaged drums are placed for handling (Figure 7-2).
- If there is a potential for a spill, a berm or dike should be built around the drums to contain spilled liquid.

**Weight Limits**

Although there are no legal maximum limits for weights that a worker may lift manually, the Department of Labor recommends a 23-kg (50-lb) limit for objects that are regularly lifted. Under no circumstances shall an individual push or pull a load that exceeds 275 kg (600 lb.). Tasks that require frequent lifting of heavy objects should only be performed by workers who have been properly trained and are physically qualified.



**Figure 7-2.** Overpack drums are used for leaking and damaged drums.

### Lifting Guidelines

The following guidelines should be followed when lifting heavy objects:

1. Inspect the load for sharp edges, deterioration, and wet or greasy spots.
2. Wear appropriate gloves when lifting or handling objects with sharp or splintered edges. To ensure a good grip on the object, the gloves must be free of oil, grease, or other slippery materials.
3. Wear appropriate PPE when lifting or handling waste containers.
4. Inspect the route over which a load will be carried. The route should be free of obstructions that could cause tripping, slipping, or spillage.
5. Consider the distance a load will be carried. Gripping power may weaken over long distances.
6. Size up a load and make a preliminary heft to be sure it's within personal lifting capacity. If it isn't, get help or use a mechanical lifting device.

7. If team-lifting is required, the individuals involved should be similar in size and physique. One person should act as the leader and give commands as to when the object should be lifted or lowered.

### *Safe Lifting Procedures*

To lift an object off the ground, use the following method:

1. Firmly place feet about 10 to 15 inches apart. Place one foot alongside the object being lifted and the other foot behind the object.
2. Use the knee-bend or squatting position. Keep the back straight (straight does not mean vertical). Tuck in the chin so the neck and head continues the straight back line.
3. Grasp the object using the palmer grip. In the palmer grip, fingers and hand are extended around the object to be lifted, using the full palm.
4. Tuck arms and elbows into the side of the body, and position the body so that the total weight of the object and body is centered over the feet.
5. Start lifting with a thrust of the rear foot, keeping the object close to the body. Lift with the legs. Do **not** lift with the back.
6. Carry the load close to the body—not on extended arms. To turn or change position, shift the feet. Do not twist the back.
7. To set an object on the ground, follow the above procedure in the reverse order.

### **HANDLING SPECIFIC CONTAINERS**

Workers may encounter a large number of waste containers, such as boxes, cartons, bags, barrels, drums, and cylinders. As a general rule, when handling waste containers, always:

- Work in teams of at least two people (buddy system)
- Stay in visual range with team members at all times
- Be able to communicate with other team members and the site safety and health officer (*S&HO*)

The primary purpose of handling waste containers is to first identify or characterize the contents. Once the material is identified, the containers may be further handled to organize them into groups based upon:

- Compatibility of the contents
- Method for on-site disposal
- Method to be used for shipment off-site for disposal (in drums, bulk tankers, etc.)

## Visual Inspection

A visual inspection should be made before physically handling any container. This inspection provides a preliminary classification for the containers. The classification determines the appropriate procedure to be used in handling each different class (type) of container.

Look for the following items when performing a preliminary inspection:

- Words, symbols, labels, or other markings
- Company names, batch numbers, stenciled information
- Signs of wear and deterioration, such as rust, corrosion, or leaks
- Container type (Table 7-1)
- Swelling or bulging that indicates the drum is under pressure
- The type of drum head ( drum top) (Table 7-2)
- The quantity of material in the container

**Table 7-1.** Special container types and their associated hazards

Polyethylene or PVC-lined drums	Often contain strong acids or bases. If the lining is punctured, the contents will quickly corrode the outside steel wall, resulting in a significant leak or spill.
Specialized metal containers	Expensive or specialized containers (e.g., stainless steel). Usually indicate an extremely dangerous material.
Double-walled drums for use as a pressure vessel	Have fittings for both product filling and placement of an inert gas such as nitrogen. Can contain reactive, flammable, or explosive substances.

**Table 7-2.** Drum head configuration can give information regarding the contents of a drum.

Configuration	Information
Two bung steel (TBS)	Designed to contain liquid.
Full removable head (FRH)	Designed to contain solid material.
Lined	Contains a liquid. Material may be corrosive or hazardous.

The results of this type of inspection may provide clues to the container's contents and its hazards. Air monitoring around the container may provide additional information about its contents.

**Note:** It's common on uncontrolled hazardous waste sites for waste containers, especially drums, to have no reliable labels or markings. Even if labels or markings are present, they might be incorrect. Containers were frequently reused without erasing or changing the original labels or markings.

When the inspection is finished, the results may be used to classify the container into groups of the same type. For example:

- Container type
- Leaking and/or deteriorated
- Bulging
- Containing explosive/shock sensitive materials
- Containing radioactive materials
- Containing small volume individual containers, laboratory waste, or other dangerous materials
- Containing corrosive materials

## Planning

Every step of a material handling operation should be carefully planned. The information found during the preliminary inspection can be used to determine:

- Potential hazards and procedures to be used to minimize danger
- Containers to be moved or opened for sampling
- Containers that need to be overpacked before moving

A preliminary handling plan is then developed and includes the following information:

- Amount and type of handling required
- Handling equipment
- Workers selected for job
- PPE required
- Appropriate procedures based on hazards identified

### **Radioactive Materials**

If a container has labels or markings indicating that ionizing radiation is present, immediately signal for an area evacuation and contact the S&HO. Do **not** handle any container that may contain radioactive material until trained personnel survey the area and evaluate the situation. Only workers who have been trained on radiation hazards and who know how to protect themselves are allowed into these areas.

### **Explosive Or Shock-Sensitive Waste**

If a container is suspected of containing explosive or shock-sensitive waste as determined by visual inspection, contact the S&HO before handling. Crystallized material around the opening is a common sign that shock-sensitive material is inside. If handling is necessary, use extreme caution and follow these steps:

1. Move all unnecessary personnel a safe distance away.
2. Use a grappler unit constructed for explosive containment for initial handling of such containers.
3. Place and secure containers on pallets before moving.
4. Use an audible siren system, such as the ones used in conventional blasting operations, to signal the end of explosive waste handling activities.
5. Maintain continuous communication with the S&HO and/or the command post.

### **Bulging Drums**

A bulging or swelling drum may indicate that the drum is under pressure. Pressurized drums are extremely hazardous. Whenever possible, do not move drums that are bulging or swelling. If they have to be handled, workers should be in a Level B ensemble as a minimum.

If a pressurized drum has to be moved, handle the drum with a grappler unit constructed for explosive containment. Move the bulged drum only as far as necessary to carefully overpack the drum.

Under appropriate supervision, the drum pressure may be relieved by venting or carefully loosening the small bung. When the drum heads are bulging and swollen, relief of the over pressure must be done very carefully. Proper PPE must be worn.

### **Laboratory Packs**

*Laboratory packs* are drums containing individual containers of laboratory materials normally surrounded by cushioning and absorbent material. Such containers should be considered explosive or shock-sensitive wastes until identified otherwise.

When handling a lab pack is required, precautions should be taken, such as:

- Ensure all unnecessary personnel have moved a safe distance away before handling or moving lab packs.
- Whenever possible, use a grappler unit constructed for explosive containment.
- Maintain continuous communication with the S&HO and/or the command post.
- Once a lab pack has been opened, have a chemist inspect, classify, and separate the containers.

### **Leaking, Open, or Deteriorated Drum**

Sometimes drums filled with liquids cannot be moved because of the danger of them breaking open. In this situation, transfer the liquid to another drum using a pump designed for moving that specific liquid. Drums with the following characteristics should be placed in overpack drums immediately:

- Leaking drums that contain sludge or semi-solids
- Open drums that contain liquid or solid waste
- Deteriorated drums that can be moved without breaking

**Overpacking**

Overpack drums are made to contain damaged drums or containers. The most common size is the 85-gallon overpack drum designed to hold a 55-gallon drum. There are different methods of placing a damaged drum into an overpack drum:

**Method 1:**

1. Place the damaged drum on its side.
2. Slide the drum into the overpack drum using pieces of cardboard as a sliding surface.

**Method 2:**

1. Pick up a damaged drum with a forklift using a device that grabs the chime. (The chime is the joint of the body and the head.)
2. Exercise care if the chime is damaged as pressure from the lifting device can cause more damage to the drum.
3. Raise the damaged drum with a lift and position it above the overpack drum.
4. Lower the damaged drum into the overpack drum.
5. Remove the lifting device after the damaged drum is inserted into the overpack drum.

**Note:** Be sure the material being placed in an overpack drum is compatible with the overpack drum. For example, if a corrosive material is placed in a metal overpack drum, it will corrode the drum.

**Drum Repair**

Sometimes, a drum can be repaired after it has been determined that the drum is structurally sound and there is no risk of leaking. Drums can develop leaks in a variety of ways, the most obvious being a puncture from improper use of material handling equipment. Rough handling during loading for shipment or storage can also damage the chime, which leads to leaks.

**Buried Drums**

At some sites, drums or containers may be buried and will have to be uncovered before they can be sampled or handled. Special precautions must be taken when excavating drums:

- Before excavation, the employer or S&HO must determine if there are any underground utilities in the area. If there are, they must be located and protected. Workers should also make sure that equipment doesn't come near overhead power lines.
- Cave-ins are a hazard when walls and faces of excavations and trenches are over five-feet deep. Workers must be guarded by a shoring system, ground sloping, or some other equivalent means.
- A competent person must inspect trenches and excavations daily to assure adequate slopes, shoring, and bracing, and to check for evidence of possible slides or cave-ins. More frequent inspections are required as work progresses or after rain or snowfall.
- When removing the soil from around drums, use great caution to minimize the potential for drum rupture.
- Have a dry chemical fire extinguisher on hand to control small fires.

**CHARACTERIZATION**

*Characterization* is the process of sampling material to identify the chemical composition of unknown or potentially hazardous materials. It is required for all waste containers. In addition, routine samples of soil, water, and air are required to ensure that chemical contaminants are maintained below regulatory limits.

Data collected from characterization is used to determine how to safely and efficiently package and transport hazardous wastes for treatment or disposal. Some wastes are bulked, which means the contents of individual drums are combined in a larger container. When bulking is used, wastes must be sufficiently characterized to determine if they can be safely combined. To obtain this data, standard tests should be used to classify the wastes into general groups.

When possible, materials should be characterized using an on-site laboratory. This provides data as rapidly as possible. It also reduces the time before action can be taken to handle any hazardous materials.

## **SAMPLES FOR LABORATORY ANALYSIS**

Laboratory analysis consists of analyzing a field sample for chemical composition or contaminants under controlled conditions. It is usually required when the chemical composition of a material is incomplete or unknown.

As part of the laboratory analysis, material sampling must be performed. There are two major categories of material sampling:

1. Bulk sampling for solids and liquids
2. Wipe sampling on surfaces

Many types of sampling methods and techniques can be used to collect samples. Most sampling activities are done by trained technicians. However, workers are involved in the sampling process or collecting routine samples from drums, tanks, pits, ponds, and lagoons. The sample and collection method chosen is usually based on the physical state of the material (gas, liquid, or solid), and/or its chemical characteristics.

## **Bulk Sampling**

Bulk sampling refers to the collection and analysis of solid, liquid, or gaseous materials. Its primary purpose is to identify and measure chemical contaminants. It is also used to develop baseline information to characterize the existing status of a site and document compliance during cleanup. This information is used to develop the Site Safety and Health Program.

Common types of bulk samples include:

- Solid samples (soils, powders, sludges, etc.)
- Liquid samples (surface water, groundwater, drums, tanks, etc.)
- Air samples (grab samples)

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Sampling Strategy

Collecting bulk samples can be dangerous to worker safety and health because workers often have direct contact with unknown wastes. Before collecting any sample, review the sampling plan for the following information:

- Background information about the waste.
- Type of sample (solid, liquid, gas) and container being sampled.
- Appropriate sampling device(s) and container(s).
- Number, volume, and location of samples to be taken.
- Standard operating procedures (SOPs) for opening a container, sampling, and sample packaging and handling.
- PPE to be worn while sampling and handling the sample. This decision will be based on what is known about the wastes and the site conditions.

## Sampling by Hand

When sampling unknown waste by hand, use the following techniques:

- Stay up wind.
- Keep a safe distance during sampling and while containers are opened.
- Cover container tops with plastic sheeting or other suitable noncontaminated material to avoid direct contact.
- Use remote sampling techniques when feasible.
- Do **not** lean over containers to sample other containers unless it is absolutely necessary.
- **Never** stand on containers. Always use mobile steps or platforms to safely collect samples in high places.
- Do **not** use contaminated items, such as used rags, to sample. They can contaminate the sample or be incompatible with the waste in the drum.

### Sampling Equipment

The type of equipment used to collect a bulk sample depends on the physical state of the material, its location, and the frequency samples are required. Some of the more commonly used types of equipment include:

- Spade and scoop
- Auger and thin-wall tube samplers
- Colawasa and glass tubes (thief)
- Manual and automatic suction pumps

### *Spade and Scoop*

One of the simplest methods of collecting a solid sample is with a spade and scoop. For soil samples, a lawn or garden spade is used to remove the top cover of soil to the needed depth, and a smaller stainless steel scoop, lab spoon, or trowel is used to collect the sample. This method works with most soil types. A flat, pointed mason's trowel is used to cut a block of soil when required.

The following procedure is used for sampling with a spade and scoop.

1. For soil samples, carefully remove the top layer of soil to the desired sample depth with an uncontaminated spade.
2. Using an uncontaminated stainless steel scoop or trowel, place the sample in a 1-gallon (3.8 liter-) plastic sample bag. (A typical sample should be approximately one quart and weigh three pounds.)
3. Secure and tape the bag to achieve an air-tight seal.
4. Label the bag with the appropriate sample tag. Be sure to label the tag carefully and clearly, using all the required information. Complete all chain of custody documents and record in the field logbook.

### *Auger and Thin-Wall Tube Sampler*

The auger and thin-wall tube sampler consists of an auger bit, a series of drill rods, a T-handle, and a thin-wall tube corer. Use this system when sampling soils near the surface or to depths of 6 to 8 feet (1.83 to 2.44 meters).

This system can be used for many soil conditions. It can be used to sample surface soil by simply driving the corer into the soil without preliminary boring. It can also be used to depths in excess of 10 feet (3.05 meters). However, sampling depths usually do not exceed 6 feet (1.83 meters) because of rock layers and the possible collapse of the borehole.

The following steps outline the procedure for using the auger and thin-wall tube sampler.

1. Attach the auger bit to a drill rod extension and attach the T-handle to the drill rod.
2. Clear the area to be sampled of any surface debris (twigs, rocks, litter). It may be advisable to remove the first 3 or 4 inches (7.62 to 10.16 centimeters) of surface soil for an area of about 12 inches (30.48 centimeters) around the drilling location.
3. Begin drilling. Periodically remove accumulated soil from around the drill. This prevents loose material from being accidentally brushed down the bore hole when removing the auger or adding drill rods.
4. After reaching the desired depth, remove the auger from the bore hole.
5. Carefully lower the corer down the bore hole. Slowly force the corer into the soil. Take care to avoid scraping the bore hole sides. Do **not** hammer the drill rods. The vibrations may cause the bore hole walls to collapse.
6. Remove corer and unscrew drill rods.
7. Remove cutting tip and core from device.
8. Discard top of core (about 1 inch or 2.54 centimeters), which represents any material collected by the corer before going through the targeted layer. Place remaining core into sample container.

9. Label the sample container with the appropriate sample tag. Complete all chain-of-custody documents and record in the field logbook.
10. Place the properly labeled sample container in the proper carrying container.

### Liquid Sampling

Collecting liquid samples from containers can be dangerous to a worker's safety and health because workers often have direct contact with unknown wastes. Before collecting any sample, review the sampling plan, which should contain the following information:

1. Background information about the waste.
2. Which containers should be sampled.
3. The appropriate sampling device(s) and container(s).
4. Number, volume, and location of samples to be taken.
5. SOPs for container opening, sampling, and sample packaging and handling.
6. PPE to be used during the sampling and handling of the sample. The PPE will be based on the known information about the wastes and site conditions.

### *Colawasa and Glass Tubes (Thieves)*

Liquid samples from opened containers (such as 55-gallon drums) can be collected using lengths of glass tubing called thieves. The glass tubes are normally about 4 feet (1.22 meters) long, and 1/2 inch to 3/4 inch (1.27 to 1.91 centimeters) in diameter. Larger diameter tubes may be used for thicker liquids if sampling with the small diameter tube does not work.

After sampling, the tubing is broken and discarded either in the sampled container or in a separate disposal container.

Glass tubes are a quick, inexpensive way of collecting waste samples in containers. However, sample loss is a major problem when sampling some liquids. Splashing

can also be a problem. The appropriate protective clothing should always be worn, such as an apron, face shields, and boot covers.

The following steps outline the procedure for sampling with a glass thief.

1. Open the container being sampled. Listen for escaping air to indicate pressure release.
2. Insert the thief into the container, almost to the bottom. Try to keep at least 1 foot (.31 meter) of tubing above the top of the container.
3. Hold the thief in the container until the liquid waste in the tube is level with the waste in the container.
4. Cap the top of the thief with a safety-gloved thumb or rubber stopper. Do **not** touch the contaminated portion of the thief.
5. Carefully remove the thief from the container and insert the uncapped end into the sample containers.
6. Release the thumb or stopper on the thief and fill the sample container to about 75% full.
7. Repeat steps 2 through 6 if more sample is needed.
8. Cap and label each sample container with the following information:
  - Sample identification number
  - Name of the person taking the sample
  - Location
9. Dispose of the thief appropriately.
10. Replace the waste container cover.

#### Miscellaneous Sampling

It may be necessary to sample other types of containers and locations, such as:

- Tank trucks
- Elevated tanks
- Compressed gas cylinders
- Ponds and lagoons

Each of these situations is unique. Each presents its own set of hazards which needs to be identified in the sampling plan.

**Surface Sampling**

Surface samples are collected by wiping a surface that is potentially or suspected to be contaminated with a chemical or biological agent. Cellulose or cotton filters are used for the sampling. These filters are analyzed to determine the amount of surface contamination. Surface contamination can be a significant source of external exposure due to direct contact with the skin. It can be an internal hazard if it becomes airborne and is inhaled, or if it is transferred from the skin to the mouth and ingested.

**Surface Contamination**

Surface contamination is either fixed or removable.

- Fixed contamination – Contamination that can't be readily removed from surfaces, such as by casual contact. It may be released when the surface is disturbed, such as buffing, grinding, or using volatile cleaning liquids. Over time it may weep, leach, or otherwise become loose or transferable.
- Removable/transferable contamination – Contamination that can be removed from surfaces. It may be transferred by casual contact, wiping, brushing, or washing. Air movement across removable/transferable contamination could cause it to become airborne.

***Indicators of Possible Contamination***

Possible clues or signs that indicate the presence of contamination include:

- Dusty, hazy air
- Damaged containers
- Unexplained worker contaminations at exit points
- Higher than normal background readings on monitoring equipment
- Airborne monitor alarms

*Sources of Contamination*

Contamination occurs when a hazardous material is spread to an unwanted location. The following conditions are sources of contamination:

- Leaks or breaks in containers or systems.
- Opening containers or systems without proper controls.
- Airborne contamination deposited on surfaces.
- Poor housekeeping practices in contaminated areas.
- Excessive motion or movement in areas of higher contamination.
- Sloppy work practices that result in cross-contamination of tools, equipment, or workers.

*Response to Contamination Indicators*

If workers recognize unidentified contamination sources or indicators, they should follow these guidelines:

- Secure the work area
- Notify co-workers of the situation
- Isolate the source, if possible, and exit the area
- Notify the supervisor

*Sampling Procedure*

The following steps outline a general procedure for collecting a surface sample:

1. While wearing disposal latex gloves, fold and place a new filter in a clean, labeled vial, then cap the vial. (Several vials may need to be prepared.)
2. Prior to sampling don a clean pair of disposable gloves.
3. Open one of the vials and withdraw and unfold the filter.
4. Moisten the filter with an appropriate agent, as stated in the sampling plan.
5. Wipe a surface area of approximately 100 cm<sup>2</sup> with the filter. (This area is equal to an “s” pattern approximately 18-inches long.)

6. Fold the filter, with the exposed side inward, and insert it back into the original vial.
7. Cap and label each vial with the following information:
  - Sample identification number
  - Time and date of sample
  - Name of the person who took the sample
  - Site location of the contamination
  - Sampling area

## **MATERIAL STORAGE**

Every attempt should be made to minimize drum handling. However, sometimes drums must be staged or moved in an organized manner to predesignated areas. Staging helps characterization and cleanup. It also protects drums from potentially hazardous site conditions, such as movement of heavy equipment, extreme temperatures, or sunlight. Any of these conditions might cause an explosion, ignition, or pressure buildup.

### **Storage Practices**

It is essential to properly store hazardous materials to ensure the safety and health of workers handling them. The following practices are used when storing hazardous materials:

- Labeling
- Securing
- Storing according to compatibility

### **Labeling**

Labeling hazardous materials for shipping should be done according to the standard procedure developed for a particular site. It must also be in compliance with DOT and/or International Civil Aviation Organization (ICAO) regulations.

The site's specific labeling procedures generally require that the following information is included on the label:

- Location from which material was obtained
- Identification number
- Potential or known hazards

**Securing**

Once materials are properly labeled, they can be stored on site in any area that is secured against unauthorized personnel. This requirement protects those who are unaware of the hazards associated with the stored materials. It also ensures the integrity of the materials (i.e., materials can't be tampered with or altered by vandals).

**Storing According to Compatibility**

The storage area must be compatible with the materials being stored so that conditions within the storage area do not affect the materials in any adverse way. For instance, flammable materials should be stored in cool areas away from any source of ignition.

Materials stored together in an area should also be compatible as a group. Never store incompatible materials together in the same storage area unless the materials are separated by appropriate berms, dikes, and/or structures, such as walls. Incompatible materials must be separated and stored on racks or stacked in appropriate stable piles. To prevent earthquake damage, secure the racks with "tiedowns." The following types of hazardous materials must only be stored under appropriate conditions:

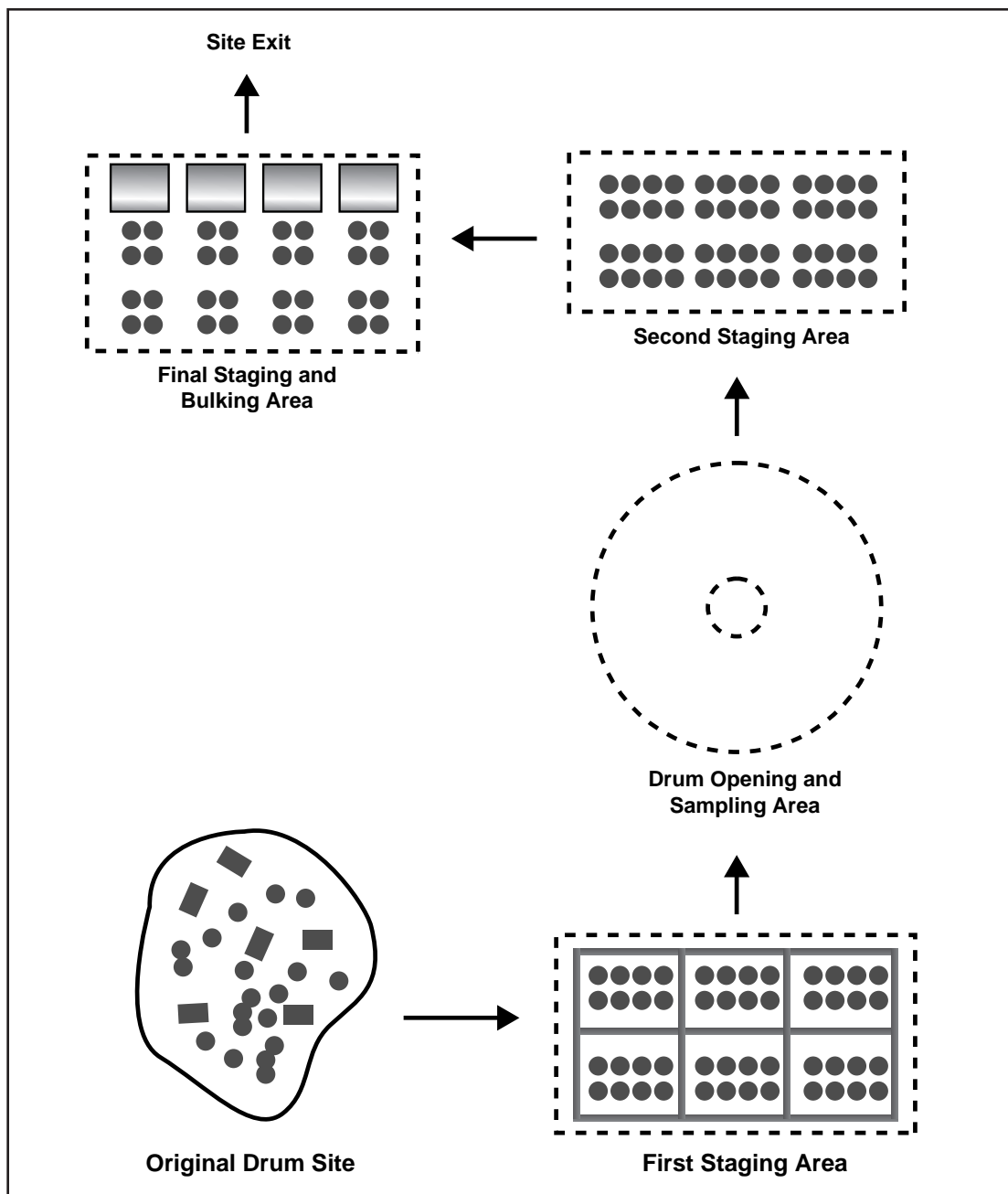
- Radioactive
- Fissile (able to undergo fission)
- Flammable
- Explosive
- Oxidizing
- Corrosive
- Pyrophoric (able to ignite spontaneously)

**Storage Facilities**

Materials to be stored shall not exceed either the rated floor capacity for the area or the weight capacity of the storage racks. The load limit and the maximum height to which materials may be stacked shall be posted in a conspicuous location. Traffic lanes and loading areas shall be marked appropriately and kept clear. The floors in these areas shall be maintained in good condition at all times.

Figure 7-3 shows a typical staging arrangement. The number of staging areas needed depends on site-specific circumstances, such as:

- Type of operation
- Accessibility of drums in their original positions
- Perceived hazards



**Figure 7-3.** A typical staging arrangement that allows drums to be separated according to their chemical characteristics.

In all staging areas, stage the drums two wide in two rows per area. Space the rows seven to eight feet apart to allow room for drum handling equipment. General rules for staging are:

1. Locate the final staging area as close as possible to the site's exit.
2. Grade the area and cover it with plastic sheeting.
3. Construct approximately 1-foot high dikes around the entire area.
4. Separate drums according to their basic chemical categories as determined by characterization. Examples include acids, organics, inorganics, and pesticides.
5. Construct separate areas for each type of waste present.

## **Bulking**

Wastes that have been identified as compatible are often mixed together and placed in bulk containers. This practice is called *bulking*. For example, tank trailers or vacuum trucks are bulk containers that transport wastes to treatment or disposal facilities. Bulking is performed at the final staging area using the following procedure:

- Inspect each tank trailer and remove residual materials before loading any bulked materials. This will prevent adverse chemical reactions.
- To move hazardous liquids, use pumps that are properly rated and have a safety relief valve with a splash shield. Make sure the pump hoses, casings, fittings, and gaskets are appropriate for the material being pumped.
- Inspect hose lines before beginning work to make sure that all lines, fittings, and valves are intact.
- Use drip pans under pumps, hoses, etc., whenever possible.

**TRANSPORTATION**

Once materials have been properly classified, packaged, and labeled, they can be prepared for transport. Personnel responsible for shipment of hazardous materials should ensure that proper classification, packaging, and labeling procedures have been followed. The shipper must then fill out the shipping papers according to the appropriate regulations (normally DOT and state).

All objects loaded onto trucks must be firmly secured to the truck to prevent them from shifting during transit. The wheels of trucks being loaded or unloaded should be blocked to prevent movement.

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**SECTION 7 - ASSIGNMENT SHEET**

1. Match the following words with the proper definition or example.

\_\_\_\_\_ Auger and thin-wall tube sampler

a. Equipment used to sample soils near the surface.

\_\_\_\_\_ Bulging drums

b. Glass tube used for collecting liquid samples.

\_\_\_\_\_ Lab pack

c. Made to contain damaged drums or containers.

\_\_\_\_\_ Overpack

d. Drums containing individual containers of lab materials.

\_\_\_\_\_ Thief

e. Drums that were once under pressure.

2. List the three major categories or types of samples that might be collected.

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3. Identify five items that are looked for during the preliminary inspection.

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4. Name five indicators of possible contamination.

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5. List the actions to take if a contamination source or indicator is found.

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6. List the four general rules for staging.

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**SECTION 7 - STANDARD OPERATING PROCEDURE 1****Sampling Procedures**

- A. Collect a soil sample with a spade and scoop.
1. For soil samples, carefully remove the top layer of soil to the desired sample depth with an uncontaminated spade.
  2. Using an uncontaminated stainless steel scoop or trowel, place the sample in a 1-gallon plastic sample bag. (A typical sample should be approximately one quart and weigh three pounds.)
  3. Secure and tape the bag to achieve an air-tight seal.
  4. Label the bag with the appropriate sample tag. Be sure to label the tag carefully and clearly, using all the required information. Complete all chain of custody documents and record in the field logbook.
- B. Collect a soil sample with an auger and thin-wall tube sampler
1. Attach the auger bit to a drill rod extension and attach the T-handle to the drill rod.
  2. Clear the area to be sampled of any surface debris (twigs, rocks, litter). It may be advisable to remove the first 3 or 4 inches (7.62 or 10.16 centimeters) of surface soil for an area of about 12 inches (30.48 centimeters) around the drilling location.
  3. Begin drilling and periodically remove accumulated soil from around the drill. This prevents loose material from being accidentally brushed down the bore hole when removing the auger or adding drill rods.
  4. After reaching the desired depth, remove the auger from the bore hole.
  5. Carefully lower the corer down the bore hole. Slowly force the corer into the soil. Take care to avoid scraping the bore hole sides. Do **not** hammer the drill rods. The vibrations may cause the bore hole walls to collapse.
  6. Remove corer and unscrew drill rods.
  7. Remove cutting tip and core from device.
  8. Discard top of core (about 1 inch or 2.54 centimeters), which represents any material collected by the corer before going through the targeted layer. Place remaining core into sample container.
  9. Check that a Teflon® liner is present in the cap. Secure the cap tightly.

10. Label the sample bottle with the appropriate sample tag. Complete all chain-of-custody documents and record in the field logbook.
11. Place the properly labeled sample bottle in the proper carrying container.

C. Collect a bulk sample from a drum with a drum thief (glass tube).

1. Open the container being sampled.
2. Insert the thief into the container, almost to the bottom. Try to keep at least 1 foot (.31 meter) of tubing above the top of the container.
3. Hold the thief in the container until the liquid waste in the tube is level with the waste in the container.
4. Cap the top of the thief with a safety-gloved thumb or rubber stopper. Do **not** touch the contaminated portion of the thief.
5. Carefully remove the thief from the container and insert the uncapped end into the sample bottle/vial.
6. Release the thumb or stopper on the thief and fill the sample bottle/vial to about 75% full.
7. Repeat steps 2 through 6 if more sample is needed.
8. Cap and label each sample bottle/vial with the following information:
  - Sample identification number
  - Name of the person taking the sample
  - Location
9. Dispose of the thief appropriately.
10. Replace the waste container cover.

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**SECTION 7 - STANDARD OPERATING PROCEDURE 2****Drum Inspection and Overpacking**

- A. Inspect a drum before handling, using the following steps:
1. Don the proper PPE.
  2. Look for and record words, symbols, labels, or other marks.
  3. Look for and record company names, batch numbers, and stenciled information.
  4. Look for signs of wear and deterioration such as rust, corrosion, or leaks.
  5. Look for and record drum type.
  6. Note any swelling or bulging (drum under pressure).
  7. Determine the drum head configuration.
- B. Overpack a leaking or deteriorated drum, using the following steps:
1. Don the proper PPE.
  2. Have enough absorbent material nearby to soak up spills.
  3. Build a berm or dike around the drum to contain spilled liquid.
  4. Make sure the proper overpack is available.
  5. Handle the drum carefully at all times.
  6. If the drum is on its side, use pieces of cardboard or lumber as a sliding surface and guide the damaged drum into the overpack.
  7. If the drum is upright, place the overpack over it and tip both of them over.
  8. If a lift is being used, use caution when placing the overpack under it. Lower the damaged drum.
  9. If any material has spilled, or absorbent material was used, pick it up with a shovel and place it in the overpack.
  10. Fasten the overpack lid securely.
  11. Label the overpack with the proper label.

**SECTION 7 - STANDARD OPERATING PROCEDURE 3****Uncovering and Staging Drums**

- A. Uncover buried or partially buried drums using the following steps:
1. Don the proper PPE.
  2. Have enough absorbent material nearby to soak up spills.
  3. Make sure you have the proper overpack available.
  4. Determine if there are any underground utilities in the area.
  5. Check for overhead power lines if heavy equipment will be used.
  6. If excavations and trenches are over five-feet deep, take proper precautions such as shoring and/or sloping.
  7. Have a dry chemical fire extinguisher on hand.
  8. If drums are suspected to contain flammables use non-sparking tools.
  9. Remove the soil very carefully to reduce the potential for drum rupture.
  10. Cover the drums with polyethylene until necessary sampling is done.
- B. Stage drums from the recovery area to the staging area using the following steps:
1. Don the proper PPE.
  2. Grade the staging area and cover with polyethylene.
  3. Construct dikes, one foot in height, around the staging area.
  4. Inspect the drums.
  5. Make sure you have absorbent materials, overpacks, and fire extinguisher available.
  6. Handle all drums carefully.
  7. If they are leaking, overpack it or plug it.
  8. Put drums on pallets if using forklifts or machinery.
  9. If using manual equipment, place the drum onto the drum cart.
  10. Transport the drum(s) to the appropriate staging area. Materials are usually separated according to the materials they contain, e.g., corrosives, radioactive, explosive or shock sensitive, etc.
  11. Cover the transported drums with polyethylene to keep out rain and/or snow. Securely fasten the polyethylene to make sure it doesn't blow off.



# HAZARDOUS WASTE WORKER MANUAL

Section

**8**

Title

**WORKPLACE  
MONITORING**

## TRAINEE OBJECTIVES

After completing Section 8, you will be able to:

1. List five reasons for conducting workplace monitoring.
2. List the two major approaches for identifying and/or measuring chemical, physical, and biological hazards.
3. Identify one type of direct reading instrument, its limitations and purpose.
4. Identify five hazards that may need to be identified and evaluated under the workplace monitoring program.
5. Identify five limitations or factors that may affect an instrument's ability to detect hazards.
6. State the appropriate response to the following conditions:
  - Combustible gas and oxygen indicator alarm is activated
  - Personal monitoring/sampling device fails
  - Continuous air monitor alarm sounds
7. List five reasons for conducting laboratory analysis of workplace samples.

## Standard Operating Procedures

1. Air sampling with draeger pump.
2. Combustible gas and oxygen meter operation.



**INTRODUCTION**

Many of the activities performed during hazardous waste operations involve the potential for employee exposure to chemical, physical, and biological hazards. These hazards can threaten a worker's health and safety. This section introduces the fundamentals of workplace monitoring and focuses on the specific elements used to evaluate worker exposure to chemical contaminants.

Workplace monitoring is an ongoing process that begins during site characterization and continues to the end of the clean-up project. The information gathered from observations, research, the sample analysis, and real-time monitoring is used to develop a site safety and health program. The program is designed to identify, evaluate, and control safety and health hazards on site, and to provide for emergency response during site operations. The safety and health program outlines the workplace monitoring requirements, which are:

- Frequency and types of air and personnel monitoring.
- Environmental sampling techniques and instrumentation.
- Maintenance and calibration methods for monitoring and sampling equipment.

**WORKPLACE MONITORING**

*Workplace monitoring* is the process of collecting, detecting, and measuring the workplace for chemical, physical, and biological hazards. The two principle approaches for identifying and/or measuring these hazards are:

1. Direct reading instruments (*DRI*)
2. Laboratory analysis of workplace samples.

The main objective of workplace monitoring is to ensure that exposures stay below regulatory limits.

**Reasons for  
Workplace Monitoring**

Workplace monitoring provides the necessary information for making decisions about worker health and safety. Important reasons for workplace monitoring are to:

- Identify hazards.
- Evaluate the effectiveness of engineering controls and work practices.
- Assess worker exposures to chemical, physical, and biological agents.
- Determine compliance with occupational and environmental regulations.
- Locate and evaluate potential sources of contamination (poor work practices, faulty engineering controls, etc.).
- Determine the level of worker protection needed.
- Evaluate uncertain exposures.
- Identify the need for further sampling requirements.

**When Workplace  
Monitoring is  
Required**

Workplace monitoring is required in the following situations:

- During initial entry when the site evaluation shows the potential for ionizing radiation and/or immediately dangerous to life or health (*IDLH*) conditions.
- When chemical exposures above the permissible exposure limits (*PELs*) are suspected.
- When airborne concentrations of contaminants are suspected to exceed the protection factors of the personal protective equipment (*PPE*) in use.
- When flammable or oxygen-deficient environments are suspected.
- When entering or working in permit-required confined spaces.
- During an emergency response.

**Types of Hazards**

Health and safety hazards are assessed under the workplace monitoring program, including those introduced by remediation technologies and equipment. This assessment includes the following common hazards:

- Toxic chemicals – Characterized by the presence of vapors, gases, and aerosols that have an adverse health effect on the human body.
- Oxygen deficiency – An atmosphere containing less than 19.5% oxygen.
- Flammable atmospheres – Presence of ignitable or explosive vapors, gases, aerosols, or dusts.
- Corrosive chemicals – Materials which upon contact with human tissue cause severe irritation and destruction.
- Total and respirable dust – Inert materials suspended in air.
- Noise – Energy in the form of sound waves that damages the ears and causes hearing loss.
- Temperature extremes – Hot or cold temperatures which put extreme stress on the human body.
- Biological agents – Microscopic living organisms that have adverse health effects on the human body.
- Ionizing radiation – High energy in the form of waves or particles which have the ability to cause cellular damage in the human body.

**DIRECT READING INSTRUMENTS**

Direct reading instruments (*DRI*s) are usually small compact devices used to detect and measure airborne contaminants and energies, such as radiation and noise. There are several major advantages in using *DRI*s:

- Provides information at the time of sampling
- Allows for rapid decision-making
- Responds to a broad category of chemical and physical hazards

Initially, DRIs were developed for use in industrial settings. They functioned as early warning devices in areas where a leak or accident could release a high concentration of a known chemical into the surrounding atmosphere. With advancements in technology, many DRIs are now sensitive enough to detect contaminants in concentrations below one part per million (ppm).

### **Types of Direct Reading Instruments**

Many types of DRIs are used to monitor workplace conditions. Most monitoring activities are done by trained technicians. However, workers may be required to wear, observe, or use DRIs. Therefore, it's valuable for workers to understand how DRIs work, their limitations, and their uses. The type of DRI used during hazardous waste operations depends upon the following:

- Hazards being monitored (noise, radiation, chemicals)
- Physical states of the material being monitored (gas, solid, liquid)
- Purpose of monitoring

For example, different DRIs may be used for hazard identification, exposure assessment, and early warning devices. The three major categories of DRIs are:

1. Portable DRIs
2. Personal monitoring devices
3. Fixed (stationary) monitoring devices

### **Limitations**

DRIs have basic limitations in their ability to detect hazards. Before wearing or using a DRI, workers should understand how the following factors affect the accuracy and reliability of its readings:

- Proper operation
- Calibration and checks
- Detection range
- Response time
- Interference
- Environmental conditions

### Proper Operation

For a DRI to respond accurately, it must be operating correctly and functioning properly. Some preliminary checks and measures can be performed to ensure that an instrument is functioning properly:

- Battery check – Most instruments have a battery monitoring function that notifies an operator when the battery needs recharging or replacement.
- Instrument warm-up – All instruments need time to warm up before an accurate reading can be taken. Warm-up times vary from one second to as long as 30 minutes, depending on the instrument being used.
- Instrument condition – To ensure the proper operation, the DRI should be cleaned and maintained on a regular basis.

### Calibration and Checks

When sampling and analyzing an unknown atmosphere, the DRI internally compares it to a known reference gas. This reference gas is called a *calibration gas*. To ensure DRIs are providing accurate results, a calibration check should be performed before and after each use. The check should follow the manufacturer's instructions and use the appropriate calibration gas. A calibration check is performed by observing the meter response after connecting a calibration gas to the DRI. If the DRI's response is within the specifications for the calibration gas, the instrument is properly calibrated.

If a DRI's response is outside the specifications of the calibration gas, it must not be used until it's calibrated or readjusted. Depending on the instrument, air monitoring devices may be calibrated in % LEL, ppm, or % gas. The manufacturer's instructions in the instrument's operating manuals should be followed for calibration, maintenance, and use. Do **not** use an instrument if it doesn't have a current calibration sticker.

### Detection Range

DRIs are designed to detect specific hazards within a certain range or concentration. For example, a DRI that is sensitive to 1 ppm, can't be used to measure an atmosphere containing a chemical below that level, such as .1 ppm. The DRI won't detect the chemical. Also, an area with high energy or chemical concentrations can cause the DRI's readout to go off scale.

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Response Time	<p>Response times may vary among DRIs, and any single DRI's response time may be affected by the following factors:</p> <ul style="list-style-type: none"><li>• Length of the sample hose – The shorter the hose, the faster the response.</li><li>• Flow rate of pump – A slower flow rate means a longer response time.</li><li>• Response of DRI – Most DRIs have a response time between 5 and 60 seconds. The DRI must be kept in the test area for the length of the response time specified in the operator's manual.</li><li>• Contaminants – Other contaminants may affect a DRI's response.</li></ul>
Intrinsic Safety	<p>Since most DRIs use electronic circuitry, they can be a source of ignition in an explosive environment. When instruments are going to be used in areas containing potentially flammable atmospheres, they must have the Underwriters Laboratories (<i>UL</i>) or Factory Mutual (<i>FM</i>) stamp of approval. This stamp indicates that the instrument is intrinsically safe for use in flammable atmospheres.</p>
Interference	<p>Manufacturers provide information about chemicals and/or conditions that may interfere with their instruments' ability to respond accurately. Some vapors and gases can interfere with a DRI's ability to provide accurate readings and can cause false readings. For example:</p> <ul style="list-style-type: none"><li>• Lead in leaded gasoline permanently damages the filament in a combustible gas detector.</li><li>• Carbon dioxide poisons the cell in an oxygen meter.</li><li>• Certain vapors and gases can react with detector tubes to produce false responses.</li><li>• High levels of moisture, such as fog or rain.</li></ul>

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Consult the operations manual to identify interference problems and change to a different type of DRI if the problem continues.

**Note:** Calibration checks with a known gas do **not** solve interference problems.

#### Environmental Conditions

Environmental conditions, such as temperature, humidity, and barometric pressure, can affect an instrument's operation. For example, high humidity prevents the detection of some gases and vapors when using a photoionization detector. Humidity can also interfere with the chemical reactions that take place inside a detector tube. Consulting the operations manual and performing an in-the-field calibration check helps operators assess the effect of environmental conditions.

#### **PORTABLE DIRECT READING INSTRUMENTS**

Portable DRIs are commonly used to perform surveys and gather information required for decisions. Some of the more common types of portable instruments include:

- Combustible gas/oxygen indicator
- Flame ionization detector
- Photoionization detector
- Detector tubes
- Sound level meter

#### **Combustible Gas and Oxygen Indicator**

The combustible gas and oxygen indicator (*CG/OI*) is a dual purpose instrument that detects and measures areas for combustible gases and oxygen deficiency. Many CG/OIs also monitor for other commonly encountered toxic gases, such as carbon monoxide and hydrogen sulfide.

The CG/OI has an adjustable combustible gas and oxygen concentration alarm which can be fixed to a preset value. When the combustible gas or oxygen concentration reaches the preset alarm point, a horn or a bell sounds and a red alarm light turns on. This allows the instrument to be used as a continuous air monitor in most work areas.


CG/OIs are intended for use in atmospheres with normal oxygen concentrations. They are not to be used in atmospheres that are oxygen-enriched. Oxygen concentrations significantly lower or higher than those of normal air can cause incorrect readings.

The CG/OI is easy to operate. However to be safe and effective, it must be used by a qualified individual who is trained to interpret the results. This individual must be knowledgeable in the instrument's operation, limitations, and calibration procedures.

Some of the applications for using a CG/OI include:

- Monitoring a space or work area for flammable vapor concentrations.
- Monitoring a space for oxygen deficiency.
- Verifying the effectiveness of purging, inerting, and ventilating operations.
- Acting as a continuous air monitoring station.

Table 8-1 lists the features and limitations of the CG/OI.

<b>Table 8-1.</b> Combustible gas and oxygen indicator.		
<b>Instrument</b>	<b>Features</b>	<b>Limitations</b>
Combustible Gas and Oxygen Indicator (CG/OI) 	<ul style="list-style-type: none"> <li>• Measures oxygen concentration and combustible gas concentration as a percentage of the lower explosive limit (LEL).</li> <li>• Lightweight, portable, and easy to use.</li> <li>• Visible and audible alarms.</li> <li>• Probes and sample lines provide remote sensing capabilities.</li> <li>• 8 to 12 hours of battery life.</li> <li>• Accuracies of <math>\pm 2</math> to 3% are attainable.</li> </ul>	<ul style="list-style-type: none"> <li>• Potential interferences from leaded gasoline and silicates.</li> <li>• Most models do not measure specific gases.</li> <li>• May not function properly in atmospheres containing less than 10% oxygen.</li> <li>• High humidity may interfere with the oxygen cell.</li> <li>• A strong oxidizer may cause an artificially high oxygen readout.</li> </ul>

### Flame Ionization Detector


The flame ionization detector (*FID*) is a portable DRI used to detect organic compounds. It is a type of organic vapor analyzer (*OVA*). (Organic compounds are chemical compounds containing carbon, such as toluene and benzene.)

An FID can operate in two modes: 1) survey mode; and 2) gas chromatograph (*GC*) mode. In survey mode, the FID detects the total concentration of contaminants in the tested atmosphere. In GC mode, it detects and measures individual components (i.e., benzene, xylene, toluene), with detection limits as low as a few ppm. To obtain accurate readings, instrument operators must be thoroughly trained in FID operation and data interpretation. FIDs may be used for the following:

- Assist in choosing the appropriate level of respiratory protection
- Verify the effectiveness of ventilation
- Monitor for trace contaminants

Table 8-2 lists the features and limitations of the FID.

**Table 8-2.** Flame ionization detector.

Instrument	Features	Limitations
Flame Ionization Detector (FID)  	<ul style="list-style-type: none"> <li>• Measures the total concentration of organic materials in the air. In GC mode, it can identify specific compounds.</li> <li>• Lightweight and portable.</li> <li>• 8-hour battery life, 3-hour if using a strip recorder.</li> <li>• Reads from 0 to 1,000 ppm.</li> </ul>	<ul style="list-style-type: none"> <li>• Should not be used in temperatures below 40°F.</li> <li>• System modification required in oxygen-deficient and high concentration atmospheres.</li> <li>• Does not detect inorganic gases and vapors.</li> <li>• Requires experience to operate and interpret data.</li> </ul>


## Photoionization Detector

Another type of OVA is the photoionization detector (*PID*), a portable instrument used to detect many organic and a few inorganic gases and vapors. This instrument is factory calibrated to benzene and will respond to benzene concentrations as low as .2 ppm. The primary use of a photoionization detector is identical to that of the FID. However, the PID is easier to use, costs less, and has a faster response time.

A PID is designed for trace gas analysis in normal air. PIDs may be used for the following:

- Aid in choosing the appropriate level of respiratory protection
- Verify the effectiveness of ventilation
- Monitor for trace contaminants

Table 8-3 lists the features and limitations of the PID.

Table 8-3. Photoionization detector.		
Instrument	Features	Limitations
<p>Photoionization Detector (PID)</p> 	<ul style="list-style-type: none"> <li>• Measures the total concentration of organic and inorganic materials in air.</li> <li>• Lightweight, portable, and fairly easy to operate and interpret data.</li> <li>• 10-hour battery life, 5-hour if using a strip recorder.</li> <li>• Reads from 0 to 2,000 ppm.</li> </ul>	<ul style="list-style-type: none"> <li>• Does not detect methane.</li> <li>• Must have the correct probe to detect certain compounds.</li> <li>• Does not identify individual components.</li> </ul>

**Detector Tube**


A colormetric detector tube is a glass vial containing a chemical which reacts with the contaminant being monitored. It is capable of measuring the concentrations of a wide variety of compounds. A pump is used to draw a known volume of air through the detector tube. The chemical concentration is determined from the color change in the tube. This color change is the result of a chemical reaction between the detector tube's chemical and the contaminant.

Detector tubes may be used for the following:

- Screen for specific organic and inorganic gases and vapors
- Detect leaks

Table 8-4 lists the features and limitations of colormetric detector tubes.

**Table 8-4.** The colormetric detector tube.

Instrument	Features	Limitations
Detector Tube 	<ul style="list-style-type: none"><li>• Provides a measure of both volatile organic and inorganic materials in air.</li><li>• Simple to use and inexpensive.</li></ul>	<ul style="list-style-type: none"><li>• Low accuracy of (<math>\pm</math>) 25%.</li><li>• Requires previous knowledge of gases and vapors in order to select the appropriate detector tube.</li><li>• Some chemicals will react with the tube and cause a false positive.</li><li>• Temperature and humidity may affect readings.</li></ul>

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**Sound Level Meter**

A sound level meter is a DRI that measures the intensity of sound at a given moment (Figure 8-1). Noise monitoring or measuring is required when noise levels are at or above 85 decibels (*dB*). Workers exposed to average noise levels between 85 dB and 90 dB or greater during an 8-hour workday must have hearing protection available. Workers exposed to average noise levels of 90 dB or greater during an 8-hour workday are required to wear hearing protection. Factors suggesting that noise exposures in the workplace may be at this level include:

- Employee complaints about the loudness of noise
- Indications that employees are losing their hearing
- Noisy conditions that make normal conversation difficult

Sound level meters provide a measure of sound intensity at only one point in time. It is usually necessary to take a number of measurements, several times during the day, to estimate noise exposure over a workday. If noise levels fluctuate, the amount of time noise remains at each of the various measured levels must be determined.

**Figure 8-1.** The Quest 2500 Image Sound Level Meter. (Image courtesy of Quest Technology, Inc.)

**PERSONAL  
MONITORING  
DEVICES**

Personal monitoring devices are small compact DRIs used to measure a worker's exposure to certain types of physical or chemical agents. These devices work on the same principles as portable DRIs, except they're much smaller and are carried on a worker's body. The devices are battery operated and detect various forms of energy, such as sound, temperature, and radiation, or chemical hazards, such as toxic and flammable vapors. The energy or chemical being detected is converted electronically into an audible or visible signal, then recorded.

Some of the more common types of personal monitoring devices include:

- Personal combustible gas/oxygen indicators
- Carbon monoxide monitors
- Chlorine and hydrogen sulfide monitors
- Colormetric dosimeters
- Self-reading dosimeters (noise, radiation, etc.)

**Employee  
Responsibilities**

Workers who are selected to wear a personal monitoring device should:

- Wear the device as instructed
- Not tamper with or remove the device during the monitoring period

**Response to Equipment  
Failure**

Several different things may happen when a personal monitoring device fails, such as:

- A low-battery alarm may sound
- An instrument may behave erratically
- Readings may go off the scale for no apparent reason

Follow these general steps when dealing with a failed personal monitoring device:

1. Secure the work area
2. Notify co-workers of the situation
3. Exit to a safe area
4. Notify the supervisor

Responses to personal monitoring device failure vary from site to site. Therefore, it's important for workers to find out the appropriate response for their work site.

## **FIXED MONITORING EQUIPMENT**

Fixed monitoring systems are used to warn personnel if an abnormal or hazardous conditions develops. These instruments are fixed devices that are placed in locations where a chemical release or hazardous condition may develop, and where the condition can be detected quickly. The main purpose of these instruments is to provide an early warning so workers can exit the area safely.

Some of the more common types of fixed monitoring equipment include:

- Toxic gas monitors
- Area and airborne radiation monitors
- Smoke detectors
- Combustible gas and oxygen monitors

## **Emergency Alarms and Responses**

Equipment that monitors for abnormal conditions and airborne contamination levels is placed in strategic locations throughout the workplace. It is essential for workers to be able to identify the equipment and alarms and to respond appropriately to each.

Each site is equipped with numerous fixed monitoring systems. These systems are designed to provide an audible and/or visible indication of an abnormal or hazardous condition. In the event an alarm is initiated, the worker must be aware of, and comply with, the appropriate emergency response. Some alarms that would require an emergency response include:

- Combustible gas and oxygen deficiency
- Airborne contamination
- Radiation
- Fire

**LABORATORY ANALYSIS**

Laboratory analysis consists of collecting a part (sample) of the environment and analyzing it for chemical contaminants under controlled conditions.

**Reasons for Laboratory Analysts**

Laboratory analysis is usually required in the following situations:

- When extremely low concentrations of chemicals are present, and they cannot be adequately assessed using DRIs.
- When the chemical contaminant is in the form of a solid or mist that cannot be assessed using DRIs.
- When worker exposure to chemical or physical hazards needs to be measured over an extended period of time (such as a work shift) or when special maintenance work is required.
- To assist in determining the type and frequency of *bioassay* measurements needed for workers.
- To provide an estimate of worker exposures for situations where bioassay measurements may not be available or their validity is questionable.

**AIR SAMPLES**

Air samples are used for evaluating worker exposure to low concentrations of airborne contamination. An air sampling pump is the most commonly used device for sampling workplace atmospheric conditions and occupational exposures. Sampling pumps are battery-powered or electric devices used to draw particulates, gases, and vapors through a collection medium (e.g., filter, solid or liquid sorbent) or into a collection container.

There are two types of sampling systems:

1. Active samplers mechanically pump the contaminated air through the sample collection device.
2. Passive samplers rely on natural (rather than mechanical) forces to collect the sample.

**Air Sampling Devices**

Sampling devices are usually categorized as one of the following:

- Fixed-location air samplers
- Portable air samplers
- Personal air sampler

Selection of air sampling equipment (e.g., fixed, portable, or personal air sampler) is based on the type of sample being collected. The two major types are:

1. **Area sample** – Involves placing the collection devices within designated areas and operating them over specific periods of time. Area sampling is not a direct measurement of employee exposure. However, it does provide both estimates of exposure and information about sources of exposure.
2. **Personal sample** – Involves directly connecting a monitoring or sampling device to a worker, usually within the breathing zone. The worker wears it continuously during all work and rest operations. The device will collect a sample and/or record the intensity of an agent (i.e., noise, ionizing radiation) as the worker moves from place to place. Personal sampling is usually performed on those employees with the greatest risk of exposure.

**Sampling Strategy**

In areas where workers are likely to exceed occupational exposure limits, breathing zone air monitoring should be performed continuously during occupancy. Integrated or continuous monitoring collects and records samples or measurements over a specific length of time, usually a work shift. (Real-time monitoring is one reading for a specific point in time.) Sample analysis provides an average level of a specific agent for the shift. This is important because many chemical and physical hazards are based on 8-hour exposure periods. A combination of both direct-reading and time-integrated sampling is usually performed to get a complete picture of workplace exposure and emission sources.

**Other Types of Air Samples**

Other types of air samples include:

- Breathing zone air sample – an air sample collected from the worker’s breathing environment.
- Source-specific air sample – an air sample collected near an actual or likely contamination source.
- Grab air sample – an air sample collected into a bag or container or collected over a short time period.

**Response to Air Sampler Failure**

Usually, the industrial hygiene staff will find a broken air sampler during routine filter exchanges. If a worker finds one during work activities, the worker should notify the supervisor. The supervisor evaluates the need for:

- Restriction of worker access.
- Restrictions of work activities likely to cause or involve exposures.
- Requirements for respiratory protection.
- Requirements for temporary sampling or any other control measure that might be deemed appropriate.

If a personal sampling pump fails, the worker should:

- Secure the work area
- Notify co-workers of the situation
- Exit
- Notify the supervisor



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**SECTION 8 - ASSIGNMENT SHEET**

1. List five reasons for conducting workplace monitoring.

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2. List the two major approaches for identifying and/or measuring chemical, physical, and biological hazards.

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3. Identify one type of direct reading instrument (DRI), its limitations, and purpose.

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4. Identify five hazards that may need to be identified and evaluated under the workplace monitoring program.

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5. Identify five limitations or factors that may affect an instrument's ability to detect hazards.

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6. State the appropriate response to the following conditions:

Combustible gas and oxygen indicator (CG/OI) alarm is activated

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Personal monitoring/sampling device fails

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Continuous air monitor alarm sounds

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7. List five reasons for conducting laboratory analysis of workplace samples.

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**SECTION 8 - STANDARD OPERATING PROCEDURE 1****Air Sampling with Draeger Pump**

Take an air sample with detector tubes and pump using the following steps:

1. Check the pump for leaks by inserting an unopened tube in the pump and completely compressing the bellows. The pump is in working order if the bellows have not expanded after 60 seconds.
2. Select the proper tube for testing and break off both tips of the tube in the break-off eyelet. (Be careful, the ends are extremely sharp.)
3. Tightly insert the tube in the pump head. The arrow must be pointed towards the pump.
4. Hold the pump with your thumb and palm on the top of the pump and your fingers on the bottom plate.
5. Fully compress the bellows evenly and completely.
6. Straighten your fingers and allow the bellows to fill. The limit chain will become tight. Do not restrict the bellows.
7. Repeat Steps 5 and 6 the required number of times. This number will be marked on the tube and tube package.
8. After completing this procedure, remove the tube and flush the pump by making five to six strokes. This prevents corrosion and contamination of the inside of the pump.
9. Decontaminate the pump if necessary and store in the proper location.
10. Dispose of the tube in the proper manner. The best method is to place it in a bucket of water with a small amount of baking soda for 10-30 minutes. Then discard according to area regulations. Never break open a tube.

**SECTION 8 - STANDARD OPERATING PROCEDURE 2****Combustible Gas and Oxygen Meter Operation**

Operate a LEL and oxygen meter using the following steps:

1. Inspect the instrument for any physical damage or contamination (dirt, oil, or other foreign matter).
2. Check to make sure that the unit is fully charged.
3. Check to make sure the unit has been calibrated and find out the alarm settings. The alarm in this unit can be set from 17% to 55% oxygen and 0% to 55% LEL. The alarm on the meter you will be using is set at 19.5% oxygen and 20% LEL.
4. Turn on the meter by unscrewing the collar screw on the carrying strap mounting post. Pull away the calibration cover and rotate it 180°. Tighten the collar screw.
5. The display will now read a fairly high number (88%). The reading will settle to the oxygen content in the air quickly. The oxygen content can be read directly.
6. To read the LEL, depress the black rubber button on the right side of the meter. The LEL will be displayed.
7. Fasten the meter to your ensemble and proceed to the work area.
8. The meter will continuously monitor the oxygen level and LEL level. If the alarm does sound, watch the meter and proceed to the decontamination area or a safe zone (support zone).
9. As you are retreating, take both oxygen readings and LEL readings. If the oxygen level is below 19.5%, the LEL readings may not be accurate. Proceed to the decontamination area or support zone.
10. If the LEL readings rise rapidly or erratically, you may be in an explosive atmosphere.
11. If the oxygen readings are above 25%, the LEL readings may not be accurate. Therefore, you should periodically check readings as you are working.

12. When you are done turn off the unit by unscrewing the collar screw and rotate the calibration cover 180°. Tighten the collar screw. The display should go blank.
13. After use, decontaminate with a damp, soft cloth and recharge the unit.





# HAZARDOUS WASTE WORKER

Section

**9**

Subject

**PERMIT-REQUIRED  
CONFINED SPACE**

## TRAINEE OBJECTIVES

After completing Section 9, you will be able to:

1. Define a confined space.
2. Define a permit-required confined space.
3. Describe the action to take when a space has not been classified as a confined space.
4. Identify potential physical and atmospheric hazards in confined spaces.
5. List the 15 required elements of a confined space entry permit.
6. List recordkeeping requirements for canceled permits.
7. State and explain training requirements for confined space entrants.
8. List and describe atmospheric monitoring conditions that would prohibit or terminate confined space entry.
9. List the options for communication and their limitations.
10. Match the duties of the entrants, attendants, and entry supervisors before, during, and after confined-space work.
11. List the three tests performed during pre-entry testing, in their proper order.
12. Identify when the air inside a confined space must be continuously monitored or regularly retested.
13. State and explain initial and continuous ventilation requirements of confined space work.



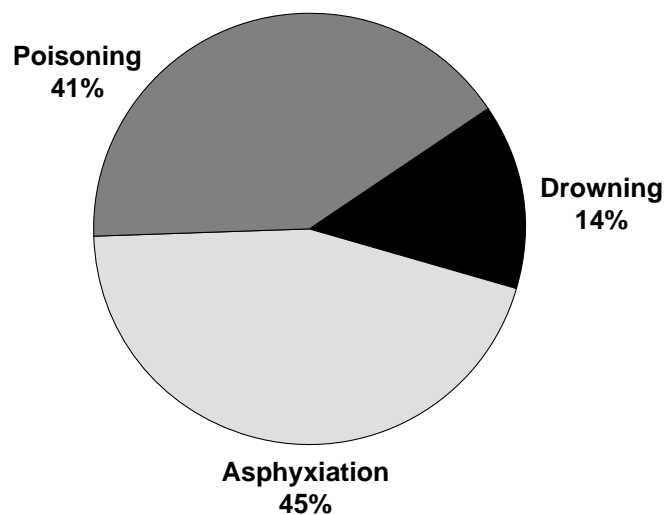
**CONFINED SPACE**

According to the Occupational Safety and Health Administration (*OSHA*), a *confined space* is any area with the following characteristics:

- Adequate size and shape to allow a person to enter
- Limited openings for workers to enter and exit
- Not designed for continuous human occupancy

Each year, more than 5,000 workers sustain serious injuries while entering or working in confined spaces. In addition, more than 300 workers die in confined-space accidents annually. Of those workers killed, 60% are would-be rescuers. Figure 9-1 shows the breakdown of confined space fatalities by cause. There are two major factors that lead to fatal injuries in confined spaces:

1. Failure to recognize and control the hazards associated with confined spaces, such as:
  - Asphyxiation
  - Electrical shock
  - Engulfment
  - Falls
  - Heat stress
2. Inadequate or incorrect emergency response. Without a predetermined emergency plan, workers usually react spontaneously to an emergency. This can result in rescuers as well as victims being hurt or killed.



**Figure 9-1.** Confined space fatalities shown by cause (NIOSH).

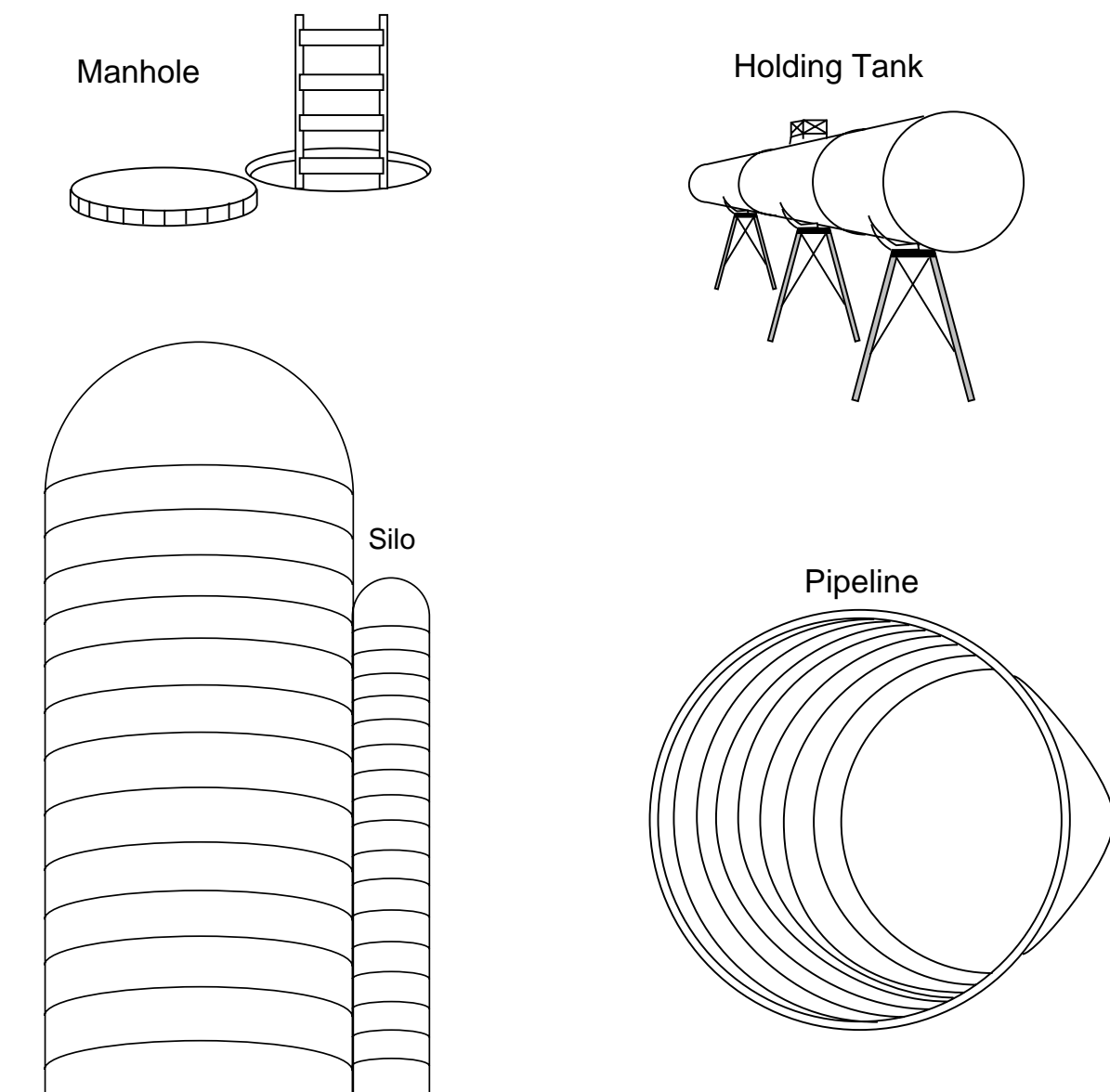
Entry into a confined space occurs when any part of a body breaks the plane of an opening. For example, just putting your head inside a confined space to look around is considered an entry.

## **PERMIT-REQUIRED CONFINED SPACE**

OSHA further defines confined space through its Permit-Required Confined Space Entry Standard (29 CFR 1910.146). This standard protects workers from the hazards associated with confined space entry operations. It requires employers to evaluate the workplace, determine if any spaces are permit-required confined spaces, and inform workers. Any space that is not classified as a confined space or permit-required confined space shall not be entered until it is classified. Do not assume that since it is unmarked, it is safe to enter. Figure 9-2 shows examples of confined spaces.

*A permit-required confined space* is a confined space with one or more of the following characteristics:

- Contains, or has the potential to contain, a hazardous atmosphere. This atmosphere can be caused by chemicals that have been stored in the space or activities that are taking place in the space. These activities include welding, cutting, or using cleaning solvents.
- Contains a material that has the potential for engulfing the *entrant* (worker entering the confined space). These materials could be granular (grains or sands) or sludges.
- Internal configuration (shape) is such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward to a smaller cross-section. A good example is a grain bin in which the space is shaped like a funnel.
- Contains any other recognized serious hazard. Examples include confined spaces with moving or electrical parts.



**Figure 9-2.** Examples of confined spaces

A hazard is any condition, situation, or agent that has the potential to produce an undesirable effect. Hazards found in a confined space can be caused by any of the following:

- Materials being stored or used in the space
- Processes taking place inside the space
- Effects of the external environment on the space

These hazards are divided into two basic categories—hazardous atmospheres and physical hazards.

## **ATMOSPHERIC HAZARDS**

Hazardous atmospheres cause the most deaths and injuries in confined spaces. OSHA divides atmospheric hazards into three categories:

- Oxygen deficient/enriched
- Flammable/explosive
- Toxic

### **Oxygen- Deficient/Oxygen- Enriched**

OSHA defines an oxygen-deficient atmosphere as one containing less than 19.5% oxygen by volume. Oxygen deficient atmospheres are dangerous because asphyxiation can occur when the oxygen content drops below normal (approximately 21%). As the oxygen percentage decreases, damaging physiological effects increase, such as faulty judgement and poor coordination. This type of atmosphere can result from chemical reactions (combustion/decomposition) and from microscopic living organisms that consume oxygen. Examples of work activities that consume oxygen are welding, cutting, or brazing.

An atmosphere containing more than 23.5% oxygen is classified as an *oxygen-enriched atmosphere*. This type of atmosphere presents a serious fire hazard. The high level of oxygen causes flammable and combustible materials to burn more violently when ignited.

### **Flammable/Explosive**

Flammable or explosive atmospheres are characterized by the presence of ignitable or explosive vapors, gases, aerosols, or dusts at a concentration greater than 10% of

their lower explosive limit (*LEL*). For a flammable or explosive atmosphere to exist, the following elements must be present, in the correct proportions:

- Fuel
- Oxygen
- Heat

## **Toxic**

Toxic atmospheres are characterized by the presence of chemical or biological agents that have an adverse health effect on the human body. OSHA defines a toxic atmosphere as any atmosphere having a chemical or biological agent in excess of its permissible exposure limit (*PEL*). Chemical agents can be solids, liquids, or gases, and affect specific target organs or areas of the body. Toxic materials are of greater concern when they are in the gaseous state because they can be inhaled.

Toxic gases come from several sources:

- Biological or chemical processes occurring inside the confined space. For example, decomposing organic material can create hydrogen sulfide, a deadly gas.
- Work activities performed in the confined space. For example, welding releases nitrogen oxides, ozone, and carbon monoxide.

Some toxic gases are particularly dangerous because they have either poor warning properties or no warning properties at all. For example, carbon monoxide gas is both colorless and odorless.

Toxic gases that have caused worker deaths in confined spaces include:

- Ammonia
- Carbon monoxide
- Chlorine
- Hydrogen cyanide
- Hydrogen sulfide
- Nitrogen oxides

**TESTING FOR  
HAZARDOUS  
ATMOSPHERES**

To ensure workers' safety, two types of atmospheric testing are conducted in a confined space:

- Pre-entry testing
- Periodic testing and continuous monitoring

OSHA 29 CFR 1910.146 provides a provision whereby an authorized entrant or their representative has the opportunity to observe any testing or monitoring of the confined spaces that is conducted prior to entry.

**Pre-Entry Testing**

Pre-entry atmospheric testing is necessary for safe entry into a confined space. It should be performed from the outside of the confined space using remote probes and sampling lines. There are three tests used to identify hazardous conditions in a confined space. They should be performed in the following order and include:

1. Oxygen level test
2. Flammability test
3. Toxic air contaminants test

It's extremely important that all areas of a confined space (top, middle, and bottom) be tested. The reason is that some vapors and gases have different vapor densities than normal air. Gases and vapors that have a vapor density value greater than one will initially settle to the bottom of a confined space. Gases and vapors that have a vapor density value of less than one will collect around the top of a confined space.

If testing reveals an unsafe atmosphere, the space must be ventilated and retested before workers enter. If ventilation is not possible and entry is necessary (i.e., emergency rescue), workers must be provided with the appropriate respiratory protection.

Workers should never trust their senses of sight and smell to determine if the air in a confined space is safe. Many toxic gases and vapors are invisible and have no odor. Also workers can't determine the level of oxygen in a confined space by sight or smell.

Oxygen Level Test	<p>The first pre-entry test is the oxygen level test. For safe entry, the oxygen level must be between 19.5% and 23.5%. Air in a confined space is hazardous if its oxygen level is less than 19.5%. Air with more than 23.5% oxygen is an extreme fire hazard.</p>
Flammability Test	<p>Measuring for flammability in a confined space is performed after the oxygen level is determined. Many combustible gas indicators (CGI) won't work properly in an oxygen-deficient atmosphere.</p> <p>Workers should assume air in a confined space is hazardous when the concentration of the flammable gas, vapor, or mist exceeds 10% of the lower flammable limit (<i>LFL</i>). It's also flammable when the concentration of airborne combustible dust meets or exceeds its LFL. After entry, if tests indicate that the atmosphere could or has become flammable, all equipment must be shut off immediately and the confined space evacuated until it's safe.</p>
Toxic Air Contaminants Test	<p>The third test measures the level of toxic air contaminants. If the concentration of any toxic substance exceeds OSHA's PEL, the atmosphere in the space is considered hazardous. The entry permit must list which toxic materials to test for and the PEL for each substance.</p>
<b>Periodic Testing and Continuous Monitoring</b>	<p>Periodic testing and continuous monitoring are necessary to ensure that the air inside the confined space remains safe while workers are inside. Immediately after entering a confined space, workers should retest the air's oxygen level, flammability, and toxicity in the following areas:</p> <ul style="list-style-type: none"><li>• All three levels of the space (top, middle, and bottom).</li><li>• Any area that couldn't be tested from outside the confined space.</li><li>• Any area where hazardous chemicals might leak or collect in the space.</li></ul>

The air inside a confined space must be monitored continuously, or retested regularly, for as long as anyone is inside the confined space. The entry permit will note whether continuous monitoring is needed or how often the air should be retested.

Continuous monitoring is important if the work being performed inside the space can cause the air to become unsafe. Potentially hazardous work activities include:

- Hotwork
- Painting
- Scraping/scaling
- Using solvents

Air monitoring sensors must be placed in the appropriate locations to perform accurate continuous monitoring. The best spots are:

- Areas where contaminants can leak into the confined space
- Workers' breathing zones

When an air monitoring alarm sounds, workers should leave the confined space immediately. The alarm indicates that a change has taken place in the air and may be approaching a hazardous condition. The hazard must be brought under control and the air retested before workers re-enter the space.

## **CONTROLLING HAZARDOUS ATMOSPHERES**

Previously we discussed some of the hazards involved in confined space entry, including:

- Oxygen-deficient atmospheres
- Flammable/explosive atmospheres
- Toxic atmospheres
- Temperature extremes

Most of these hazards can be controlled through the use of proper ventilation.

*Ventilation* is the continuous movement of fresh, uncontaminated air throughout a confined space to eliminate or reduce atmospheric hazards. Fans, blowers, or natural movement are used to move the fresh air.

There are some problems commonly associated with ventilating an area. Confined spaces have a variety of sizes, shapes, and environments and are used for many different purposes. Some confined spaces are storage tanks, either aboveground vertical tanks or underground horizontal tanks. Most of these tanks have an open interior with no internal obstructions to block air movement. However, some confined spaces, such as tankers, have internal baffles that hinder air movement. Also, some confined spaces have unusual shapes, with angles and corners that must be taken into account during ventilation.

An open tank without internal obstructions can usually be ventilated with a single blower or fan, depending on the size of the space and the capacity of the blower. Tanks with internal baffles require multiple blowers, sometimes arranged in an elaborate manner to ensure complete ventilation.

### **Toxic and Oxygen-Deficient Atmospheres**

Ventilation is the preferred method for controlling a toxic atmosphere in a confined space. Fresh air is brought into the confined space to dilute the concentration of contaminants to a safe level for entrants. If work activities within the confined space are causing a toxic atmosphere, ventilation can reduce the concentration of contaminants to an acceptable level.

Ventilation is also used when the air inside a confined space is oxygen deficient. The act of pushing uncontaminated air into the space increases the oxygen level.

### **Flammable Atmospheres**

Flammable atmospheres are prevented or controlled by either purging or inerting the confined space. Each method deals with a different element of the fire triangle.

*Purging* replaces or dilutes flammable vapors in a confined space using air, steam, or water. In a flammable atmosphere, purging eliminates the fuel component of the fire triangle.

The term *inerting*, as it applies to confined spaces, means the removal of the oxygen found inside the confined space so that ignition or combustion is not possible. The procedure uses a nonreactive gas to reduce the flammable mixture of fuel and oxygen. Usually this gas is nitrogen or carbon dioxide. Inerting removes the oxygen component of the fire triangle.

As the inert gas fills the confined space it displaces the oxygen. Therefore, a confined space must be ventilated with breathable air before entry can take place. This situation is sometimes referred to as a *double purge*.

Whichever method is used, there is the possibility of static electricity build up and a resulting spark. Therefore, it is important to bond and ground all equipment when purging or inerting a confined space.

## VENTILATION

Ventilating confined spaces is one of the best ways to control or reduce hazards, whether they are dangerous atmospheres or temperature extremes. The entry supervisor determines how a confined space will be ventilated. The procedures will then become a part of the confined space permit.

There are two basic categories of ventilation. They are referred to as general ventilation and local exhaust. *General ventilation* is the process of ventilating the entire space. Usually, fresh, uncontaminated air is used to weaken the concentration of contaminants within the confined space. Also general ventilation can be used to cool workers inside a confined space.

*Local exhaust* is a process that removes contaminants at the source from which they are generated. This process is common during welding operations inside a confined area. Fume hoods are located just above the area where

the welding is taking place. The fumes are gathered quickly into the hood before they have the opportunity to spread throughout the confined space.

### Supply and Exhaust Systems

By definition, ventilation means to “move air.” There are two systems that are used to move air: supply system and exhaust system.

A *supply system* supplies fresh air by pushing air into a space using blowers or natural air movement. *Exhaust systems* pull air from a confined space. These systems are built using fans or fume hoods. The main difference between a supply system and an exhaust system is efficiency. Air can be pushed much farther than it can be pulled. More precisely, air can be pushed 30 feet but only exhausted (pulled) 1 foot. These systems have a 30:1 exhaust to capture ratio.

### Mechanical Ventilation

*Mechanical ventilation* is the most common method of ventilation. It uses blowers or fans and ducts to ventilate a confined space. There are distinct advantages to using this method:

- It is very reliable when properly maintained
- It can be adjusted to remove contaminants from most confined spaces

There also are disadvantages to using this method:

- Initial set-up costs
- Maintenance costs
- Possible ignition sources
- Electrical and mechanical hazards
- Noise levels

Even with the disadvantages, mechanical ventilation is still the preferred way to ventilate.

**Note regarding electrical hazards:** When the possibility of a flammable or explosive atmosphere exists, the ventilation equipment must be located so that it won't be an ignition source. Also, all moving parts on mechanical devices must be sufficiently guarded.

**Natural Ventilation**

In some work environments and with perfect weather conditions, the forces of nature can actually be used to ventilate a space. In this situation, the wind velocity and direction would have to be easily forecast. However, natural ventilation is typically used to improve worker comfort and not to remove contaminants. There are several advantages to natural ventilation:

- Low noise levels
- No start up costs
- No sources of ignition
- No electrical parts
- No mechanical parts

But the main disadvantage is that wind velocity and direction are unpredictable, making natural ventilation an unreliable and sometimes dangerous method to use.

**Planning  
Considerations**

No matter which ventilation method is used, careful thought has to be given to all aspects of the confined space entry. The following should be considered:

- Previous contents
- Internal obstructions
- Existing openings
- Vapor density
- Operations in the space
- Contaminant reentrainment
- Short circuiting

**Previous Contents**

Two facts must be taken into account when choosing a ventilation method:

- The nature of the contents that previously were stored in the confined space.
- The operations that previously took place inside the area.

If hazardous materials were stored previously in the confined space, every effort must be made to clean or flush the space from the outside.

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Internal Obstructions	Some confined spaces have internal obstructions. These obstructions can include, but are not limited to, internal baffles. When a confined space contains baffles, the ventilation set-up becomes more complicated. Usually duct work will have to be threaded through the baffles. Blowers with extra capacities will be needed to push the air through the additional duct work.
Existing Openings	<p>Confined spaces have fixed openings, and special consideration must be given to how to use the openings to the best advantage. The same opening may be used for ventilating duct work and for workers to enter and exit the confined space. A piece of equipment called a <i>saddle vent</i> makes this process easier. A saddle vent connects to the duct work at the opening to make the duct narrower. This gives workers more room to enter and exit the confined space.</p> <p>Workers should be aware of any external hazards located beyond the openings, such as exhaust fumes from vehicles. Care must be taken so these hazards aren't introduced into the space.</p>
Vapor Density	If the vapor density of a chemical in the confined space is greater than one, it will initially settle at the bottom of the space. Therefore, the exhaust fans or ducts should be located at the bottom of the space where the vapors will accumulate. If the vapor density of the chemical is less than one, it will rise to the top area of a confined space. In this case, ducts should be located in the top of the space.
Operations in the Space	Work that is taking place inside a confined space can create hazards. Work operations and their hazards must be considered when setting up ventilation. One example is a storage tank that has a thick layer of sludge on its walls. Air monitoring results show the atmosphere to be relatively clean at the time of entry. But after removing the first layer of sludge, the next layer releases hazardous vapors, or the solvent used to remove the sludge is toxic. These vapors must be ventilated because the atmosphere is no longer safe. Another example is welding operations that release fumes into the space, creating a hazardous atmosphere.

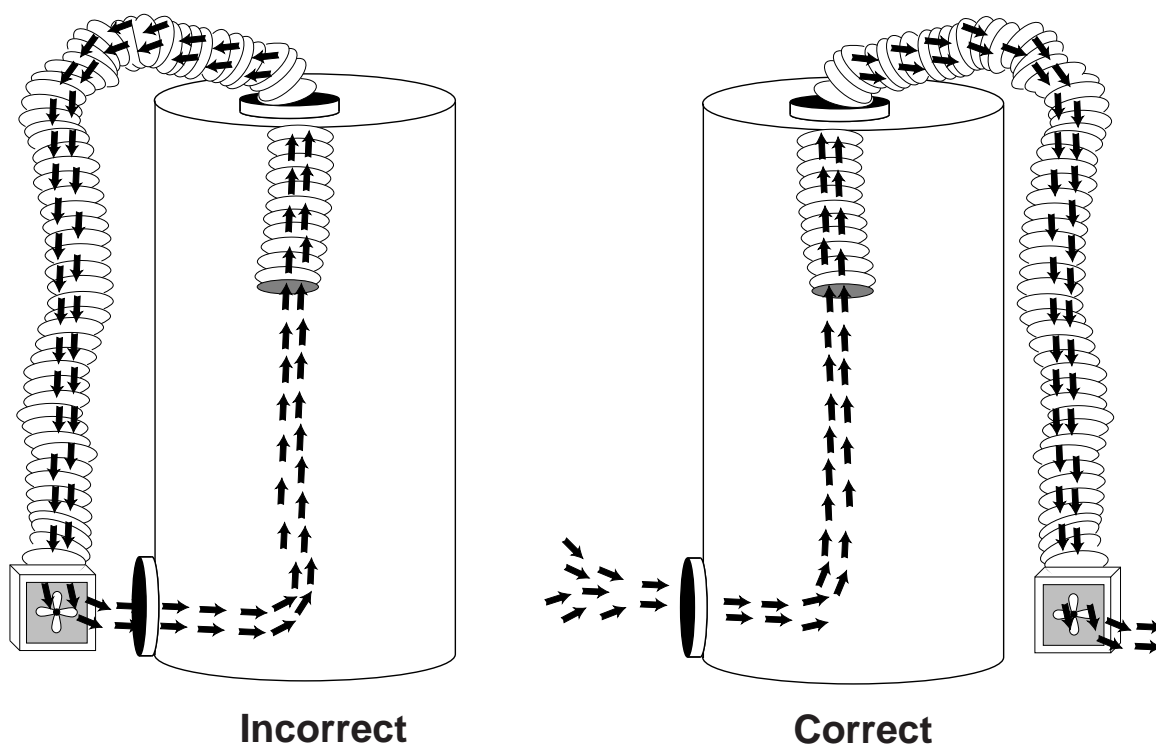
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### Contaminant Reentrainment

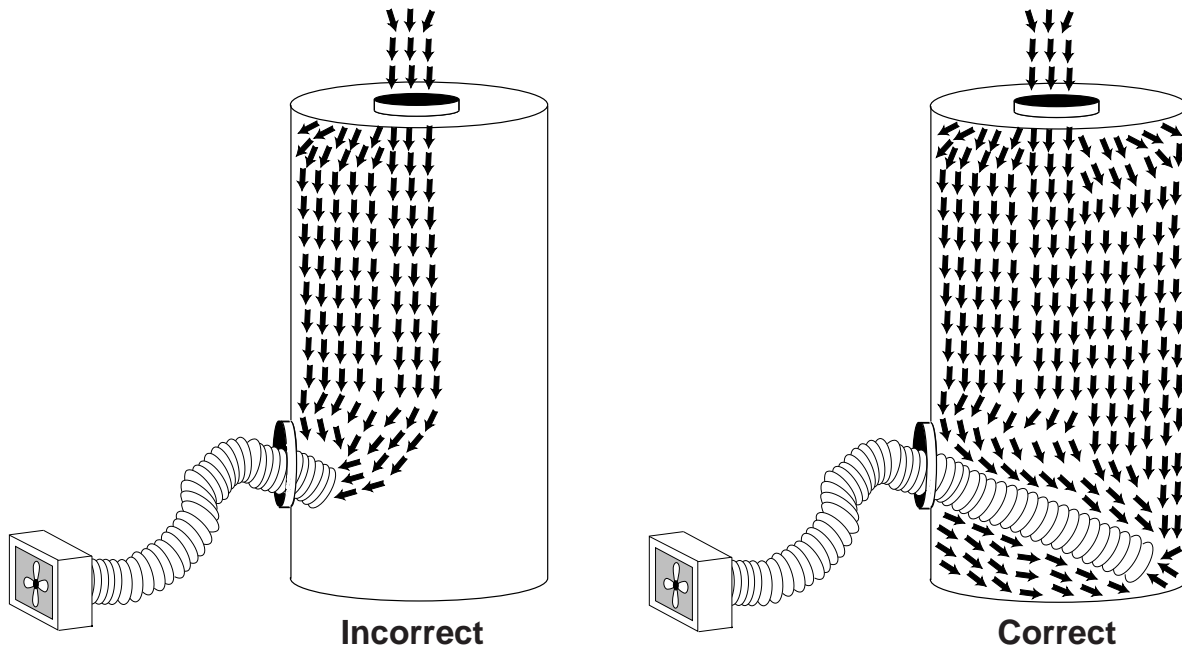
*Contaminant reentrainment* is the term given to the situation where external contaminants are drawn into a confined space (Figure 9-3). For example, when gas-powered generators are used to power electrical systems, take special care to prevent the generator's exhaust gases from entering the space. Be sure to locate fresh air intakes so the possibility of contaminant reentrainment is avoided.

### Short Circuiting

Short circuiting occurs when exhaust and supply openings are located too close together (Figure 9-4). The fresh air entering the confined space is exhausted before it can travel throughout the entire space. Therefore, be sure to allow enough distance between the supply and exhaust openings so the fresh air can travel completely through the confined space before it's exhausted.



**Figure 9-3.** During contaminant reentrainment, external contaminants are drawn into the confined space.



**Figure 9-4.** Short circuiting occurs when the exhaust and supply openings are too close together.

## PHYSICAL HAZARDS

Confined spaces can also contain physical hazards associated with the following situations or conditions:

- Engulfment
- Temperature extremes
- Noise
- Mechanical, electrical, and hydraulic systems
- Falling objects
- Wet or slick surfaces

### Engulfment

Engulfment in loose materials or liquid is one of the leading causes of death from physical hazards in confined spaces. Engulfment and suffocation are hazards associated with storage tanks, bins, silos, hoppers, and sewage treatment plants. These spaces store, handle, or transfer liquids, grains, sand, gravel, or other loose materials.

The movement of such material is unpredictable. Workers can be trapped and buried or drowned in a matter of seconds. When a storage bin is emptied from the bottom, the flow of materials forms a funnel-shaped path over the outlet. As the material empties, it can

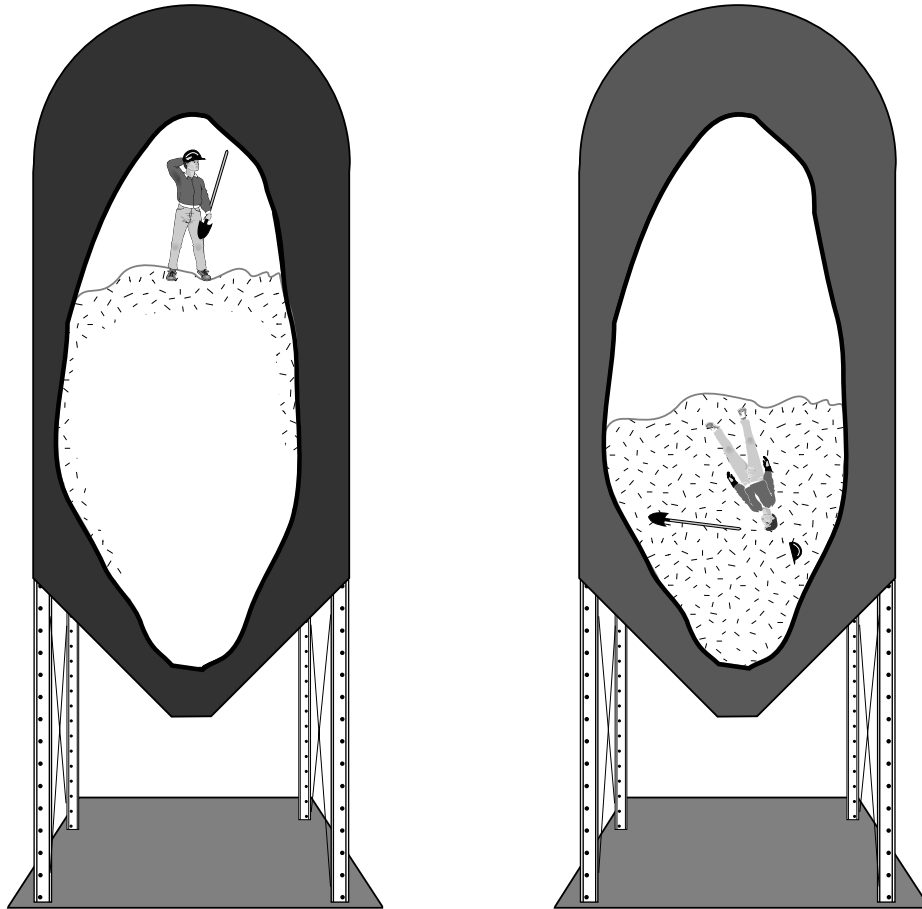
cause the top surface to act like quicksand, causing unsuspecting workers on the top to be drawn into the material. During a normal unloading operation, the flow rate can be so great that once a worker is drawn into the flow path, escape is virtually impossible.

To illustrate the danger, consider the following example. A typical flow rate for a bin unloading auger is 1,000 bushels per hour, with the flow rate fastest near the center of the funnel. The overall flow rate is equivalent to 1,350 cubic feet (ft<sup>3</sup>) per hour or approximately 21 ft<sup>3</sup> per minute. A person 6 feet tall displaces about 7.5 ft<sup>3</sup>, assuming an average body diameter of 15 inches. From the time the auger starts, there would be perhaps 2 to 3 seconds to react. In 4 to 5 seconds a person would be trapped up to their knees, and in 22 seconds, completely covered in grain.

A condition known as *bridging* can create additional hazardous situations. Bridging occurs when grain, or a similar loose material, clings to the sides of a container or vessel that is being emptied from below. A hollow space is created with a covering of grain over it. This bridge of material over the hollow space is unstable and can collapse without warning. Workers standing below or on top of the bridge can become trapped (Figure 9-5). Bridging can occur in storage bins, silos, and hoppers with any of the following materials:

- Ground grains
- Soybean or other meals
- Cement
- Limestone
- Coal
- Sawdust

Bridging occurs more readily when the diameter of the storage vessel is small and the moisture content of the stored material is high or there is high humidity.



**Figure 9-5.** When bridging occurs, a hollow space is created under a layer of material.

### **Temperature Extremes**

Extreme temperatures within a confined space can affect the health of workers and their ability to safely perform their tasks. Knowing the signs and symptoms of heat stress and cold stress can help workers prevent injury.

### **Noise**

Noise is defined as any undesirable sound with varying intensity that usually bears no information. When working in a confined space, noise can be amplified and cause damage to the ear. It also can affect the health and safety of workers. Noise becomes a hazard when it results in any of the following conditions:

- A temporary or permanent hearing loss
- A physical or mental disturbance
- Any interference with wanted sound such as voice communication, warnings, or alarms
- The disruption of a job, rest, relaxation, or sleep

**Mechanical, Electrical and Hydraulic Systems**

During confined space work, it may be difficult to separate a worker from hazardous forms of energy, such as powered machinery, electrical energy, and hydraulic or pneumatic lines. Activation of electrical or mechanical equipment can cause injury or death to workers in a confined space. Another concern with mechanical or hydraulic systems is the release of material through the lines. A release of material can engulf or drown workers. Isolation procedures prevent sudden releases of energy that can harm workers in a confined space. (Both isolation methods and procedures are discussed in greater detail later.)

**Falling Objects**

Falling objects are a potential threat in confined spaces, especially when spaces have topside openings. Tools and other objects may fall in and strike a worker. Secure tools or materials on top of the confined space so they are not accidentally dropped into the space. Also never drop materials into the space to workers. Always lower them down to prevent hitting anyone.

**Wet/Slick Surfaces**

Wet or slick surfaces create slipping and tripping hazards. In addition, wet surfaces may provide a grounding path and increase the possibility of electrocution.

**CONFINED SPACE ENTRY PROGRAM**

OSHA requires employers to have a written permit-required confined space entry program. OSHA also encourages employees to allow worker participation in the permit program and for worker access to program information developed under this standard. This program must establish procedures for controlling the hazards associated with entry into permit spaces. It must include at least the following requirements:

- Confined space entry training for authorized entrants, attendants, supervisors, and rescue personnel.
- Documented compliance through a confined space entry permit.
- Entry supervisors and attendants to control and monitor entry operations.

- Evaluation and control of permit-required space hazards.
- Identification of all permit-required spaces in the work place.
- Permit-required entry procedures.
- Posted warning signs and appropriate barriers.
- Personal protective equipment (*PPE*) and rescue equipment for authorized entrants.
- Trained and available rescue team.

### **Confined Space Entry Permit**

The OSHA Permit-Required Confined Space Standard requires employers to establish a confined space entry permit system. A *confined space permit* is an authorization form that must be completed prior to permit-required confined space entry. It explains the hazards in the confined space and how to control them. The entry permit must be posted at the entrance to the confined space for the length of the job. In addition, it must be available to authorized entrants so they can confirm that all pre-entry preparations have been made and appropriate PPE is being worn. All entry permits must be retained for at least one year after their expiration date to facilitate review of the permit-required confined space entry program. The review will ensure that workers participating in entry operations are protected from permit space hazards.

Permits are the primary source of information for the potentially hazardous atmospheres found in permit-required confined spaces. The permit's success in protecting workers comes from guiding the entry supervisor, entry attendant and entrants through a systematic evaluation of the confined space to be entered. Although entry permits have many different formats, they all must contain the following basic information:

- Location of space to be entered
- Purpose of entry
- Date and authorized duration of the permit
- Authorized entrants

- Authorized attendants
- Name of entry supervisor
- Hazards in space
- Measures used to isolate space or control hazards
- Acceptable entry conditions
- Results of initial and periodic monitoring tests
- Rescue and emergency services
- Communication procedures
- Equipment needed, such as:
  - PPE
  - Alarm systems
  - Testing, communications, and rescue equipment
- Any other necessary information
- Any additional permits issued

Entry permits vary in size, length, and number of conditions covered. Therefore, it's important that complete information be provided, especially if the person authorizing the entry will not be at the entry site. Employers must design permits specifically for the confined spaces in their work areas. For example, a permit for a steel plant will not protect people working in a waste water treatment plant.

A checklist of safety measures is usually included on the entry permit. The list should include all the equipment needed and the steps to be taken before entering a confined work space. The entry supervisor, attendant, and the entrant must review the checklist to ensure that all necessary precautions have been taken.

Some permits contain additional information that is not required but can be valuable to the specific work site. Remember, each work site must develop an entry permit form that best fits its safety needs. Figure 9-6 is one example of a confined space entry permit.

#### Explanation of Sections

An explanation is provided for each section of the confined space entry permit.

Location/Description of permit space: \_\_\_\_\_  
 Purpose of entry: \_\_\_\_\_  
 Entry authorized: From: \_\_\_\_\_ To: \_\_\_\_\_ Date: \_\_\_\_\_

Current authorized entrants:

Name	Time In/Out	Time In/Out	Time In/Out
_____	_____/____	_____/____	_____/____
_____	_____/____	_____/____	_____/____

Current attendant(s): (Print: name/time when duties assumed and relinquished)

\_\_\_\_\_

Authorizing entry supervisor: (Print: name/time/date)

\_\_\_\_\_

Current entry supervisor: (Print: name/time when duties assumed and relinquished)

\_\_\_\_\_

Known hazards: \_\_\_\_\_

Pre-entry atmospheric testing:	Reading	Time	Initials
Oxygen content:	_____	_____	_____
Flammability level (% LEL):	_____	_____	_____
Toxicity (ppm):	_____	_____	_____

Initial tests within limits? Yes: \_\_\_\_\_ No: \_\_\_\_\_  
 If no, test and record in remarks section every: \_\_\_\_\_ minutes.

Is there a known presence or potential for the presence of any other toxic hazards or flammables?

Yes: \_\_\_\_\_ No: \_\_\_\_\_

	Initial All Items	Yes	Not Necessary
1. Tank cleaned, washed, and purged:	_____	_____	_____
2. Wash water tested for neutrality:	_____	_____	_____
3. All fuses or safety jacks pulled:	_____	_____	_____
4. All lines broken and/or blanked:	_____	_____	_____
5. Observer assigned and properly instructed:	_____	_____	_____
6. Employees in the immediate area alerted to help if needed:	_____	_____	_____
7. Ventilation provided:	_____	_____	_____
8. Electrical equipment bonded and grounded:	_____	_____	_____
9. Intrinsically safe equipment required:	_____	_____	_____

Continuous atmospheric monitoring: Yes: \_\_\_\_\_ No: \_\_\_\_\_

Periodic atmospheric testing: \_\_\_\_\_ Intervals

Oxygen level: \_\_\_\_\_ % \_\_\_\_\_ Time: \_\_\_\_\_  
 Signature

Combustible Gas level: \_\_\_\_\_ % \_\_\_\_\_ Time: \_\_\_\_\_  
 (LEL) Signature

Specific air Contaminant: \_\_\_\_\_ % \_\_\_\_\_ Time: \_\_\_\_\_  
 (ppm) Signature

Chemical: \_\_\_\_\_

**Figure 9-6.** Confined space entry permit.

Required personal protective equipment:

Gloves: _____	Splash suit: _____	Boots: _____
SCBA: _____	SAR: _____	APR: _____
Goggles: _____	Glasses: _____	Face shield: _____
Body harness: _____		

Individual Responsible for PPE Selection: \_\_\_\_\_

Signature

Communications equipment/procedures to be used:

2-way radio: _____	Hand signals: _____	Alarm: _____
Radio channel to use: _____	Mobile phone: _____	Batteries in good condition: _____

Special tools and equipment - including lighting equipment: \_\_\_\_\_

All tools and equipment are safe for the environment being used in, i.e. water-tight and spark-proof:

All power cords visually inspected:	Yes: _____	No: _____
Batteries in good condition:	Yes: _____	No: _____

Emergency Rescue Procedures:

Location of written emergency response plan: \_\_\_\_\_

Type of emergencies/rescue team required: On-site: \_\_\_\_\_ Off-site: \_\_\_\_\_

Emergency rescue equipment available on-site:

Full body harness w/ D-rings: _____	
Lifelines: _____	Fire extinguishers: _____
Retrieval system: _____	Evacuation alarm: _____
PPE: _____	
SCBAs: _____	
Explosion proof emergency lighting: _____	
Powered communication equipment available/tested: _____	

Off-Site rescue service procedures: \_\_\_\_\_

Name of rescue service: \_\_\_\_\_

Phone number: \_\_\_\_\_

Rescue team notified of location, potential hazards, and route to site:

Yes: _____	No: _____
Does the rescue service have the necessary rescue equipment to meet the sites needs:	
Yes: _____	No: _____

**Authorization:** All actions/conditions necessary for safe entry into, working in, and exiting from the confined space have been performed. Entry is permitted on the date and time, and for the duration, specified above.

\_\_\_\_\_  
(Signature of authorizing entry supervisor)

**Cancellation:** All entrants have exited the confined space and this permit is canceled.

\_\_\_\_\_  
(Time)

\_\_\_\_\_  
(Signature of authorizing entry supervisor)

Describe problems encountered during entry: \_\_\_\_\_

Hot work [may] / [shall not] be conducted in this permit-required confined space.

Hot work permit issued: _____	Additional controls: _____
Other permits issued: _____	Specify: _____

Additional precautionary remarks: \_\_\_\_\_

**Figure 9-6** (cont'd). Confined space entry permit

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<i>Identity of Permit-Required Confined Space</i>	This section identifies the name and location of the permit space to be entered, the purpose of the entry, the date, and the authorized duration of the entry.
<i>Authorized Entrants</i>	This section identifies the current authorized entrants who will enter the permit space. The entrants' identity can be expressed on the permit by name or by a tracking system number (e.g., social security or employee number). Recording the names of entrants and their times of entry and exit allows the attendant to keep track of who is in the confined space at any given time.
<i>Authorized Attendants</i>	This section identifies the attendants on duty by name. If there is a change in work shifts and one attendant replaces another, then the permit must reflect the change of duty. The new attendant's name, date, and time of the duty change must be listed.
<i>Entry Supervisor</i>	This section identifies the entry supervisor who is responsible for overseeing the permit-required confined space entry. The entry supervisor's printed name, date, and time of duty must be recorded. If there is a change in work shifts and one entry supervisor replaces another, then the permit must reflect the change of duty. The new entry supervisor's name, date, and the time of duty change must be listed. The entry supervisor must also sign the permit. This signature is usually located in another part of the permit.
<i>Permit-Required Confined Space Hazards</i>	<p>This section identifies the initial hazards present in the confined space. It is not always easy to identify the hazards in and around a confined space. Therefore, pre-entry atmospheric testing is required. Testing is conducted by the designated competent person or entry supervisor.</p> <p>The initial atmospheric test results must be compared to the required limits. If the testing data is found to be above the allowable exposure limits, control measures and/or engineering controls should be used to eliminate or control the hazards.</p>

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*Hazards Control Measures*

This section contains the procedures that must be used to isolate and eliminate hazards. These measures must be satisfactorily completed before the permit can be signed.

*Acceptable Entry Conditions*

This section identifies any remaining hazards present in the confined space after all possible hazard control measures have been conducted. Continuous or periodic atmospheric monitoring may be necessary in order to ensure that conditions do not change or worsen while the entry team is in the confined space.

*Personal Protective Equipment*

This section identifies the PPE that must be worn in the permit space to comply with the acceptable entry condition requirements. A competent person must be in charge of selecting the proper PPE and this individual must sign at the bottom of this section.

*Communication Procedures Systems*

This section identifies the communication system and types of communication devices used by authorized entrants and attendants to maintain contact during entry. The type of communication device used depends on the circumstances. Voice and hand signals are used if the attendant and entrant remain within sight and hearing range of one another. However, as soon as they lose that contact, neither will be able to hear or see the commands.

Two-way radios, mobile phones, and other mechanical devices have several advantages over verbal and visual communications, including the following:

- Entrant does not have to be in visual or vocal contact with the attendant. This allows the entrant to move about the space without worrying about losing communication.
- Two-way radios and mobile phones are more dependable than hand signals or vocal communication.
- Radios and phones allow the attendant and entrant to communicate with the support zone.
- In an emergency, the attendant can summon help using either the radio or phone. This is an important advantage over visual and vocal communication.

There is one disadvantage to using radios or mobile phones. They are electrical devices and can create a spark when used. Therefore, when working in a flammable atmosphere, radios and mobile phones must be spark-proof or equipped with flame arrestors.

*Special Tools and Equipment*

This section identifies additional equipment to be used for safety and compliance with the acceptable entry condition requirements.

*Rescue / Emergency Services / Equipment*

This section identifies the emergency rescue procedures to be followed when an emergency rescue is necessary. When an off-site emergency rescue company is used, it is critical that the company be contacted and informed about the entry and its hazards prior to worker entry. All of the employees working at the site must be trained on either the off-site or on-site emergency rescue procedures. If the rescue is to be an on-site effort then it is crucial that the rescue team be adequately trained. Also the equipment must be immediately available and constantly maintained in good condition.

*Authorization and Cancellation Signatures*

This section includes the entry supervisor's signature on the authorization line of the permit. The entry supervisor's signature verifies that acceptable entry conditions have been met and entry can begin. Sometimes conditions in or around the permit space change or worsen and no longer meet the acceptable entry conditions. If this situation occurs, the entry supervisor signs the permit on the cancellation line, stopping all work. All workers must stop work and immediately exit the confined space.

*Additional Permits*

This section identifies any additional permits, such as hot work permit, that have been issued to authorize work in the permit space.

*Additional Precautions*

This section identifies any other areas that need to be included to ensure employee safety while in or around the permit space.

**Confined Space Entry Team**

Confined space work requires teamwork. Therefore, it is essential to designate a confined space entry team every time a worker enters a confined space. A confined space entry team comprises the following members:

- Entrant
- Attendant
- Entry supervisor
- Rescue personnel

A confined space entry team must always have at least two people—the attendant and entrant. However, either person can have more than one role. For example, the attendant may also be the entry supervisor. Often the confined space entry team has three or more workers. The work performed inside the space may require more than one entrant, or two attendants may be needed.

Confined space entry teams are most effective when team members are:

- Confident of each others' abilities
- Cross-trained in all functions
- Knowledgeable of each others' responsibilities

**Entrant**

The *entrant* is the worker who actually enters the confined space to work. The principle responsibility of the entrant is to complete the job assignment safely and properly. In addition, the entrant must:

- Know the hazards associated with each specific confined space entry
- Know how to use the following equipment properly for safe entry and rescue:
  - Testing and monitoring equipment
  - Ventilation equipment
  - Communication equipment
  - Lighting equipment
  - Barriers and shields
  - Tripods, lanyards, and winches for safe entry and egress
  - Rescue and emergency equipment

- Review the entry permit before entering confined space.
- Wear and use appropriate PPE.
- Use and attend to monitoring equipment and recognize signs of danger.
- Attend to own physical reactions that could signal an unsafe condition caused by the work environment.
- Maintain communications with the attendant and obey evacuation orders.
- Signal the attendant for help when sensing any reaction to chemicals.

### Attendant

The *attendant* is the worker who remains outside the confined space while the work is being done inside the space. The principal responsibility of the attendant is to make sure the entrant remains safe. The employer is responsible for ensuring that the attendant:

- Is familiar with the possible health and behavioral effects of hazard exposure to the entrant.
- Knows the hazards that may be faced during entry and make the entrant aware of them prior to entry.
- Reviews the entry permit before allowing the entrant to enter the confined space.
- Keeps track of who is in the space at all times.
- Keeps unauthorized individuals out of the area.
- Maintains continuous communication, visual or voice, with the entrant during the entry.
- Makes sure the ventilation equipment is working.
- Monitors the atmospheric testing equipment.
- Attends to the entrant's lifeline.
- Attends to the air line to prevent tangles and kinks, if applicable.

- Remains alert for early danger signs in the space.
- Watches for hazards outside and inside the space.
- Maintains clear access to and from the space.
- Notifies the entrant and orders evacuation when conditions warrant, or the permit limits expire.
- Is prepared to call for emergency assistance.
- Performs non-entry rescues as specified by the rescue procedure.
- Performs no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrant.
- Remains at the entry point except for the following situations:
  - Relieved by another trained attendant
  - Communicating an emergency
  - Self-preservation

Sometimes the confined space permit program allows attendant entry for a rescue. Attendants may enter a permit space to attempt a rescue only **if** they have been:

- Trained and equipped for rescue operations
- Relieved by a trained attendant

#### Entry Supervisor Duties

The *entry supervisor's* general responsibilities include determining if acceptable entry conditions are present at a permit space where entry is planned, authorizing entry and overseeing entry operations, and terminating entry as required by the regulations. This person may also be responsible for identifying confined spaces at a site. Specific tasks to accomplish these responsibilities include the following:

- Plan each entry:
  - Describe the work to be done
  - Evaluate the hazards of the space
  - Identify the workers involved
  - Perform (or arrange for) testing and monitoring of the atmosphere

- Ensure the entry permit is completed, dated, and signed by necessary personnel.
- Determine the need for appropriate equipment.
- Ensure atmospheric testing is performed.
- Make sure all necessary procedures, practices, and equipment for safe entry, exit, and rescue are used and maintained.
- Determine, at appropriate intervals, that working conditions remain acceptable.
- Cancel the permit and terminate work when conditions are not acceptable.
- Cancel the permit and secure the space when work is done.
- Verify that emergency help is available and that the method of summoning assistance is operable.
- Ensure compliance with OSHA, state, and local regulations.

#### Rescue Personnel

All members of a rescue team shall be provided with the equipment necessary for making rescues from a permit space. Along with being provided with the equipment, they need to be trained in its proper use. This includes PPE, as well as any rescue equipment. The members of the rescue team must also know the duties and responsibilities of the entrants.

Rescue personnel must go through an annual session to practice simulated rescues. These sessions should be as close to real life as possible, using dummies, mannequins, or actual persons to simulate the emergency. They also should be conducted so that the opening size, configuration, and accessibility of the confined space is accurately represented.

Members of the rescue team also should be trained in basic first-aid and cardiopulmonary resuscitation (CPR). At all times, at least one member of the rescue team holding current certifications in both of these areas shall be available.

An employer may decide to use an outside rescue service, such as a fire department or a Hazardous Materials (*HAZMAT*) Response Team, for the rescue team. In this case, the rescue service must have all the necessary information to conduct a rescue at the facility, including the hazards that may be encountered. In addition, the rescue service shall have access to all permit spaces before hand in order to develop appropriate rescue plans and to practice rescue operations.

To facilitate nonentry rescue, retrieval systems or methods must be used whenever an authorized entrant enters a permit space. The only time a retrieval system should not be used is when the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant.

## **RETRIEVAL SYSTEMS**

Selection of the proper retrieval equipment for a confined space entry depends upon several factors, including:

- The type and configuration of the space
- Size of the opening
- Obstacles in the space
- Whether rescue will be vertical or horizontal
- Identification of potential hazards in the space

There are different types of retrieval equipment:

- Full body harnesses
- Wristlets
- Heavy duty lifelines
- Mechanical winches
- Tripods
- Fall arrest devices
- Waist harnesses

Normally, a worker is attached to a tripod to aid in a nonentry rescue, when needed. A tripod should not be used to lower or raise a worker into or out of a confined space, unless there is no other way to enter or exit. Ladders, stairs, or other means of entrance or exit should be used first. The purpose of the tripod is to help retrieve a worker during a rescue attempt where the victim needs to be evacuated from the space as quickly as

possible. A tripod should have at least two mechanisms, one for rescue and one for fall arrest. With new advances in equipment, most tripods have one mechanism that can be used for rescue and fall protection. Winches should be self-braking to prevent a worker from free falling.

The ideal situation is to have an entrant in a full-body harness, with a main, lifesaving lanyard hooked to a D-ring on the back of the body, and a fall arrest lanyard hooked to the same D-ring. Using both lanyards aids the egress procedure by keeping the entrant stable as he/she is raised or lowered into the confined space. If this configuration is not practical then the life line should be attached in a way which establishes a profile small enough for the successful removal of the equipment. When using newer equipment with one mechanism for fall arrest and rescue, the lanyard is hooked to the back of the body.

If the use of a full-body or chest harness creates a problem for the worker, wristlets can be used. For example, wristlets are used when entering a grain silo because a silo's opening for entering and exiting is limited.

There will be different hazards associated with every confined space a worker encounters. For this reason, an entry supervisor must evaluate each confined space separately, before choosing the proper retrieval equipment to be used.

## ISOLATION

*Isolation* is the process by which a permit space is removed from service and completely protected against the release of energy and/or material into the space. An *energy-isolating device* is a mechanism that prevents the release of energy or materials. Procedures often used in isolation include:

- Lockout or tagout of all sources of energy
- Blanking or blinding
- Misaligning or removing sections of lines, pipes, or ducts
- A double-block and bleed system
- Blocking or disconnecting all mechanical linkages

Employers use isolation procedures as their primary tool for protecting workers. The confined space entry permit must list the devices and procedures that will be used to isolate the space.

### **Locking Out Energy and Material Devices**

Many workers have died when switches and valves were shut off, but not locked out. They were electrocuted, drowned, or mutilated. Tragically, there are times when lockout/tagout is not used because someone thinks it is too inconvenient. However, “one worker, one lock, one key” is a method that is safer than any OSHA standard (Figure 9-7). Ask your employer to use the safer method.



**Figure 9-7.** One Worker, One Lock, One Key

Some confined spaces have many systems that need to be locked out. One space may have electrical lines, a pump, and sewage pipes that all have to be locked out. Proper procedures for lockout/tagout must be followed to safely isolate the confined space.

### **Lockout/Tagout Energy Control Procedures**

An employer is required to implement a lockout/tagout program on site when an employee performs work on any machine or equipment that can unexpectedly release energy or materials and cause injury to the worker. The lockout/tagout program lists the energy control procedure requirements. These requirements describe in detail the

steps that must be taken to ensure that electrical devices are shut off at their power source. Energy control procedures must include the following:

- Scope and purpose.
- Authorization and rules.
- A statement on how the procedures will be used.
- Techniques used to control hazardous energy sources.
- The procedural steps needed to shut down, isolate, block, and secure machines and equipment.
- Steps designating the safe placement, removal, and transfer of lockout/tagout devices and the name of the person who has responsibility for them.
- Specific requirements for testing equipment to determine and verify the effectiveness of locks, tags, and other energy-isolating devices.

### **Limitations of the Lockout Devices**

If the energy-isolating device is lockable, the employer shall use locks unless he/she can prove that the use of tags would provide protection at least as effective as locks. When locks can't be used, the employer must comply with the tagout provisions. Employers must provide training for employees in the following limitations of tags:

- Tags are essentially warning devices affixed to energy isolating devices and do not provide the physical restraint of a lock.
- When a tag is attached to an energy-isolating device, it must **not** be removed except by the person who applied it. A tag must **never** be bypassed, ignored, or otherwise defeated.
- Tags must be legible and understood by all employees.
- Tags and their means of attachment must be made of materials that will withstand the environmental conditions encountered in the workplace.

- Tags must be securely attached to the energy-isolating devices so that they cannot be accidentally detached during use.
- Tags may provide a false sense of security. They are only one part of an overall lockout/tagout program.

**Lockout/Tagout  
Device Requirements**

Whichever lockout/tagout devices are used, they must be identified in the written lockout/tagout program. Only the devices identified in the written program can be used for controlling hazardous energy.

Additionally, all of the devices must meet the following requirements:

- Durable
- Standardized
- Substantial
- Identifiable

**Durable**

Lockout and tagout devices must withstand the environment to which they are exposed for the maximum duration of the expected exposure. Tagout devices must be constructed and printed so that they do not deteriorate or become illegible, especially when used in corrosive (acids and alkalis) or wet environments.

**Standardized**

Both lockout and tagout devices must be standardized in either color, size, or shape. Tagout devices must also be standardized according to print and format.

**Substantial**

Lockout and tagout devices must be secure and sturdy enough to minimize early or accidental removal (Figure 9-8). Locks must be strong enough to prevent removal except by excessive force with special tools, such as bolt cutters or other metal cutting tools.

Attachments used for tags must be:

- Nonreusable
- Attachable by hand
- Self-locking
- Nonreleasable, with a minimum unlocking strength of 50 lbs.



**Figure 9-8.** Lockout and tagout devices must be secure and sturdy to minimize early or accidental removal

The device for attaching the tag must also have the general design and basic characteristics of a one-piece nylon cable tie. It must be able to withstand all types of environments and conditions.

#### Identifiable

Locks and tags must clearly identify the name of the employee who applies them. Tags must also warn against hazardous conditions if the equipment or machine is energized.

A tag must include statements that can be used alone or in combination with each other (Figure 9-9). Examples include the following:

- **DO NOT START**
- **DO NOT OPEN**
- **DO NOT CLOSE**
- **DO NOT ENERGIZE**
- **DO NOT OPERATE**

Tags alone will not protect workers—locks will. Used with a lock, a tag is a good reminder.



**Figure 9-9.** Tag statements provide good reminders.

### **Blanking or Disconnecting Pipes and Process Lines**

Many confined space entrants have been injured or killed when hazardous liquids and gases leaked into the work space through pipe connections. Proper classroom and hands-on training in a company's written isolation procedure is critical for preventing injuries and death. Work processes used for isolating a pipe system after draining or depleting the line include:

- Disconnecting lines
- Blanking or blinding
- Double-block and bleed

#### **Disconnecting Lines**

Before a line can be disconnected, a competent person should review the material safety data sheets (MSDSs) for the hazardous substances in the line and surrounding area. Workers must also know if the material is under pressure or at a high temperature. All possible methods for draining the pipe line should be considered, and the safest method chosen.

Pipelines are disconnected by removing the bolts from the flanges or by unwinding some of the threaded pipe sections. *First-break* is the term used for the initial disconnection or breaking of the pipeline. *Line breaking*

is the term used for the intentional opening of a pipe, line, or duct that is or has been carrying any of the following materials:

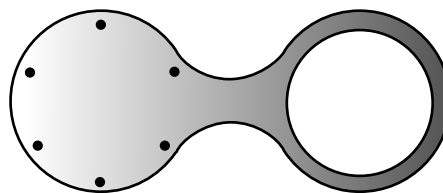
- Flammable, corrosive, or toxic materials
- Inert gases
- Fluids at a volume, pressure, or temperature that is capable of causing injury

Once a pipeline is disconnected, it can be misaligned to stop the flow of any hazardous material into the confined space.

### Blanking or Blinding

*Blanking or blinding* is the absolute closure of a pipe, line, or duct. A solid plate, such as a spectacle blind or skillet blind, is fastened over the bore to completely cover it. The plate must be able to withstand the maximum pressure of the pipe, line, or duct with no leakage beyond the plate. Otherwise, the plate could corrode or react with the material in the pipeline, causing additional hazards such as a leak or toxic fumes. The plate must fit perfectly between the flanges so the bolts can be tightened enough to prevent leakage and movement.

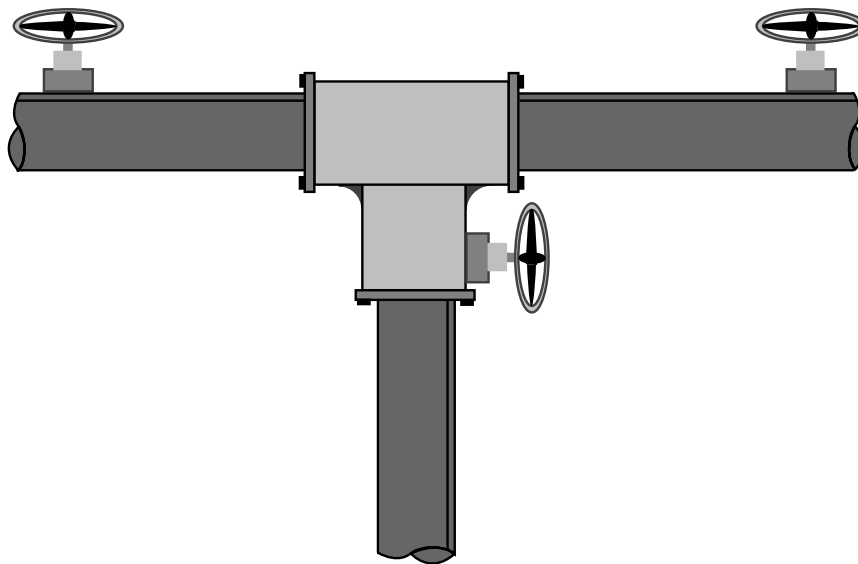
A spectacle blind is a type of blinding system. The blind looks like a pair of glasses (Figure 9-10). One blind is open and the other blind is a solid plate that closes off the line. One blind is placed inside the pipe and the other side sticks out of the pipeline. Workers can tell immediately which blind is in use by looking at the blind sticking out.



**Figure 9-10.** A spectacle blind lets workers know immediately whether the pipe is closed off or open.

**Double-Block and Bleed**

*Double-block and bleed* is a three-valve system for closing off a pipe (Figure 9-11). This system uses a T-configuration. Two valves close off each end of a section of pipe. A third valve is located at the bottom of the pipe. Material left between the two end valves is drained out by opening the bottom valve.



**Figure 9-11.** A double-block and bleed is a three-valve system.

**STAYING SAFE**

Any combination of hazards complicates working in and around confined spaces. Hazards also make emergency rescue operations more difficult. Staying safe is the responsibility of both workers and employers.

Workers must know the hazards associated with confined space entry. They are responsible for being aware of their surroundings, working safely, and properly using the safety equipment prescribed for the work activities.

Employers are responsible for informing workers of job hazards and ensuring a safe work area. They must use a variety of control measures to protect workers when a survey identifies a permit-required confined space.

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These control measures include the following:

- Conducting atmospheric testing.
- Requiring authorized entrant, attendant, and supervisor.
- Using lockout/tagout procedures.
- Providing workers with training in permit space hazards, safe work practices, and personal protective and rescue equipment.
- Using ventilation systems.

When workers and the employers work together to follow procedures, entries into permit-required confined spaces will stay safe.



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**SECTION 9 - ASSIGNMENT SHEET**

1. Define a confined space.

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2. Define a permit-required confined space.

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3. Describe the action to take when a space has not been classified as a confined space.

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4. Identify potential physical and atmospheric hazards in confined spaces.

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5. List the 15 required elements of a confined space entry permit.

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6. List recordkeeping requirements for canceled permits.

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7. State and explain training requirements for confined space entrants.

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8. List and describe atmospheric monitoring conditions that would prohibit or terminate confined space entry.

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9. List the options for communication and their limitations.

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10. Match the duties with the confined space team member.

- |                     |       |   |
|---------------------|-------|---|
| a. Entrant          | _____ | Keep track of who is in the space at all times.                       |
| b. Attendant        | _____ | Cancel the permit and stop work when conditions are not acceptable.   |
| c. Entry supervisor | _____ | Ensure compliance with OSHA regulations.                              |
|                     | _____ | Use and attend to monitoring equipment and recognize signs of danger. |

- a. Entrant
  - b. Attendant
  - c. Entry supervisor
- \_\_\_\_\_ Maintain clear access to and from the confined space.
  - \_\_\_\_\_ Signal the attendant for help when sensing any reaction to chemicals.
  - \_\_\_\_\_ Ensure atmospheric testing.
  - \_\_\_\_\_ Ensure the ventilation equipment is working.
  - \_\_\_\_\_ Remain alert for early signs of danger within the confined space.
  - \_\_\_\_\_ Cancel the permit and secure the confined space when work is done.
  - \_\_\_\_\_ Remain at the entry point except to communicate an emergency.
  - \_\_\_\_\_ Review entry permit before entering a confined space.
  - \_\_\_\_\_ Attend to the entrant's lifeline.
  - \_\_\_\_\_ Maintain continuous communication with the entrant during the entry.
  - \_\_\_\_\_ Wear and use appropriate PPE.
  - \_\_\_\_\_ Review the entry permit before allowing the entrant to enter.
  - \_\_\_\_\_ Verify that emergency help is available.
  - \_\_\_\_\_ Determine the need for appropriate equipment.

- |                     |       |  |
|---------------------|-------|--|
| a. Entrant          | _____ | Watch for hazards outside and inside the confined space.   |
| b. Attendant        | _____ | Attend to own physical reactions that could signal an unsafe condition caused by the work environment. |
| c. Entry supervisor | _____ | Keep unauthorized individuals out of the area.   |
|                     | _____ | Plan each entry.   |
|                     | _____ | Maintain communication with the attendant and obey evacuation orders.                                  |
|                     | _____ | Monitor the atmospheric testing equipment.   |
|                     | _____ | Ensure all necessary procedures, practices and equipment for safe entry are used.                      |
|                     | _____ | Ensure the entry permit is complete.   |
|                     | _____ | Be prepared to call for emergency assistance.  |
|                     | _____ | Determine that working conditions remain acceptable.   |
|                     | _____ | Notify the entrant and order evacuation when conditions warrant, or the permit limits expire.          |
|                     | _____ | Pay attention to any unusual physical reactions caused by the work environment.                        |

11. List the three tests performed during pre-entry testing, in their proper order.

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12. Identify when the air inside a confined space must be continuously monitored or regularly retested.

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13. State and explain initial and continuous ventilation requirements of confined space work.

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# HAZARDOUS WASTE WORKER

Section

**10**

Title

**SOIL AND GROUNDWATER  
REMEDiation  
TECHNOLOGIES**

## TRAINEE OBJECTIVES

After completing Section 10, you will be able to:

1. List the two categories of major sources of groundwater contamination and give three examples of each source.
2. List the three factors that influence how fast and how far a contaminant will move through the soil.
3. Define the following terms:  

Contaminant plume	Solubility
Groundwater	Volatility
Leachate	
4. Identify the three strategies used by the various remediation technologies and give two examples of each strategy.
5. List the health and safety hazards of thermal desorption, biological treatment and incineration.

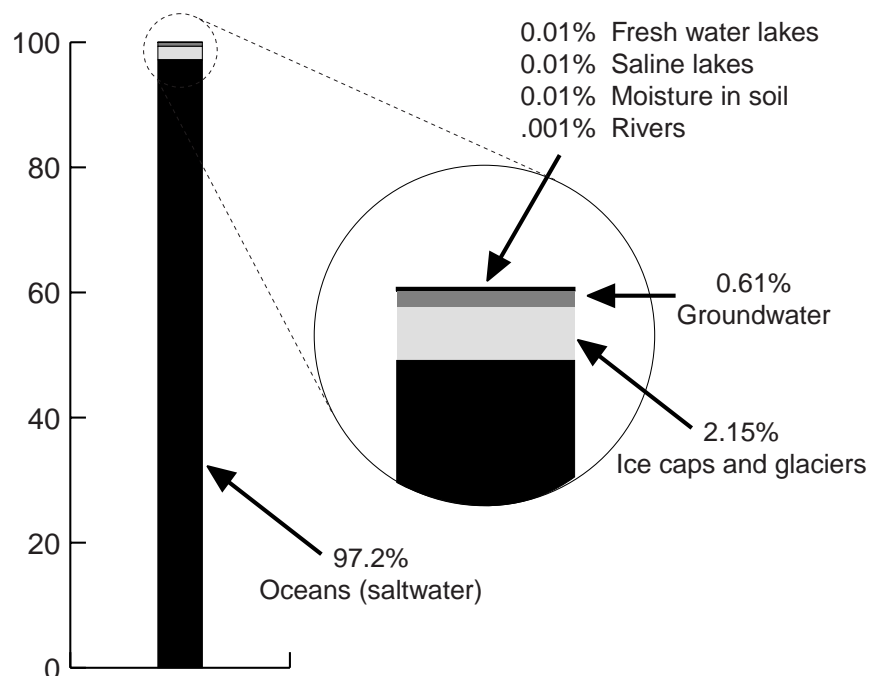


## INTRODUCTION

The average individual in the United States uses almost 100 gallons (380 liters) of drinking water a day, although only about 2.5 quarts (2.4 liters) is actually used for drinking. In light of our dependency on water, how much thought do we give to the source of our water and whether or not it is safe to drink? The answer is probably none, or very little, unless we live in a community forced to rely on alternative water supplies.

Of the world water supply, about 97% is unusable in the form of ocean saltwater. The remaining 3% comes from surface water (rivers, lakes, and reservoirs) and *groundwater*. Over 2% of this is in the form of ice caps and glaciers leaving only 1% to meet the world demand for drinking water. Figure 10-1 illustrates these statistics.

This section focuses on the sources and risks of surface and groundwater contamination, as well as the clean-up methods currently being used in the remediation industry.

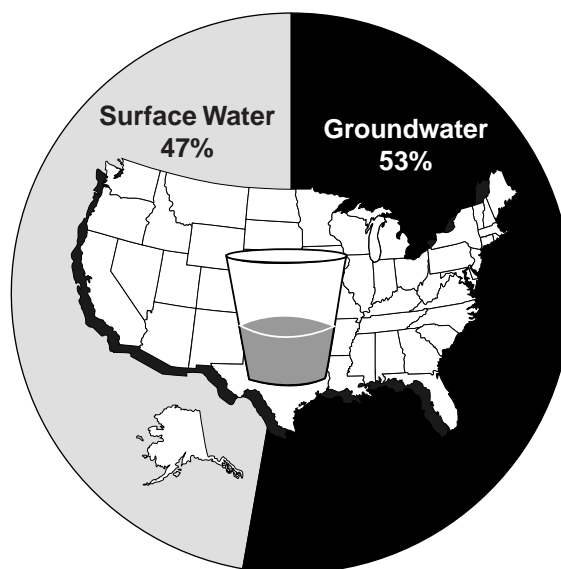


**Figure 10-1.** This graph shows the breakdown of the world water supply. Only 1% of this water supply is available as drinking water.

## GROUNDWATER

Drinking water comes from either surface water or groundwater. Large cities or populated areas tend to get their drinking water from surface water sources, such as rivers, lakes, and reservoirs. Smaller cities and rural areas usually draw their drinking water from groundwater or underground aquifers.

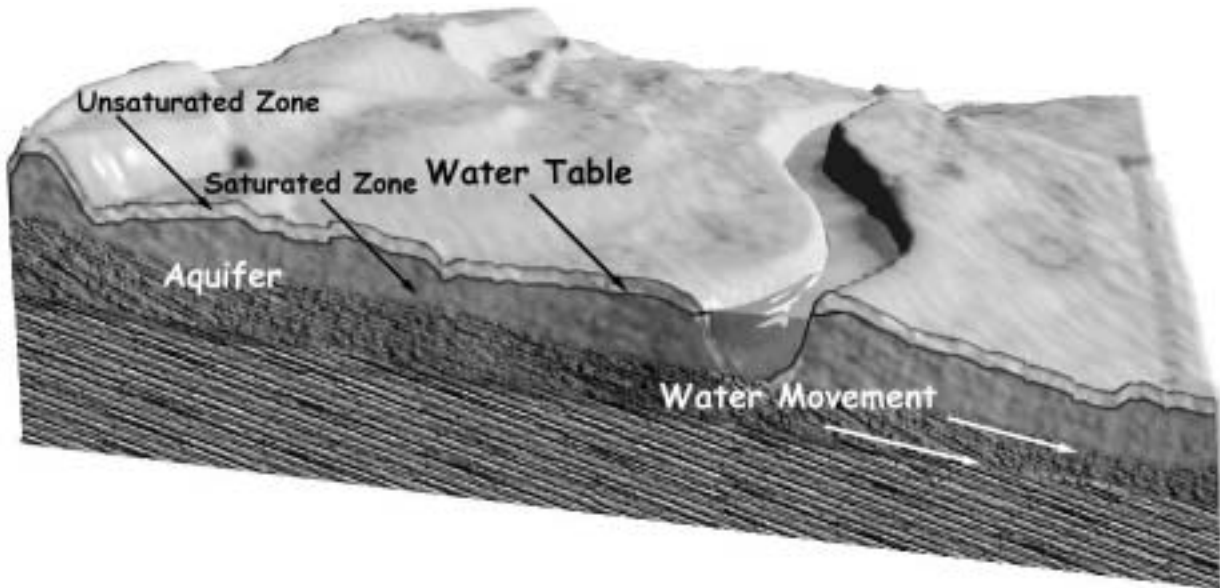
Groundwater supplies about 53% of the United States drinking water supply (Figure 10-2). In fact, an average of 800,000 water wells are drilled each year in the United States. This is equivalent to tapping into our underground water supplies at approximately 100 times each hour for domestic, farming, and commercial needs. The other 47% of the United States population gets its drinking water from rivers, lakes, and reservoirs.



**Figure 10-2.** The United States gets its supply of drinking water from both surface water and groundwater sources.

### What is Groundwater?

Beneath the surface of the earth lies two distinct areas—the unsaturated zone and the saturated zone. As Figure 10-3 illustrates, the *unsaturated zone* is the top layer of material made up of soil and rock particles. Spaces between these particles are filled with air and water. Water in the unsaturated zone is not held here. It either percolates down to the saturated zone or is taken up by plants.



**Figure 10-3.** Beneath the earth's surface lie the unsaturated zone and the saturated zone. The water table is the boundary between them.

The boundary between the unsaturated zone and the saturated zone is called the *water table*. Below the water table is the *saturated zone*. In this area all of the spaces, voids, and cracks are filled with water. It is this water in the saturated zone that is commonly called *groundwater*.

Groundwater flows slowly, moving an inch to a few feet per day. Because of gravity, it flows from *upgradient* (high pressure areas) to *downgradient* (low pressure areas). This means groundwater flows downhill with the slope of the water table, and like surface water, it flows toward and eventually drains into streams, rivers, lakes, and oceans.

Within the saturated zone are geologic formations called *aquifers*. Aquifers are composed of permeable rock or loose material, which can store, transmit, and yield a usable supply of water. Usable supply of water can mean anywhere from 100 to several million gallons of water per day. An aquifer may be small, only a few square miles in area, or very large, underlying thousands of square miles of earth. Some aquifers are a few feet thick, while others measure hundreds of feet from top to bottom. Consider the Florida aquifer, which is 2,000 feet deep at its center and lies beneath most of the state.

**HYDROLOGY**

Hydrology is the science that studies the occurrence, distribution, movement, and properties of water as well as its relationship with the environment. Knowing some basics facts can help you better understand the causes of soil and water contamination and the methods used to restore water quality.

**Hydrologic Cycle**

The hydrologic cycle illustrates the constant movement of water above, on, and below the surface of the earth (Figure 10-4). It has three phases:

1. *Evaporation*
2. *Condensation*
3. *Precipitation*

**Evaporation** - Energy from the sun turns water from soil and bodies of water into water vapors in a process called evaporation. The majority of evaporation occurs over the oceans.

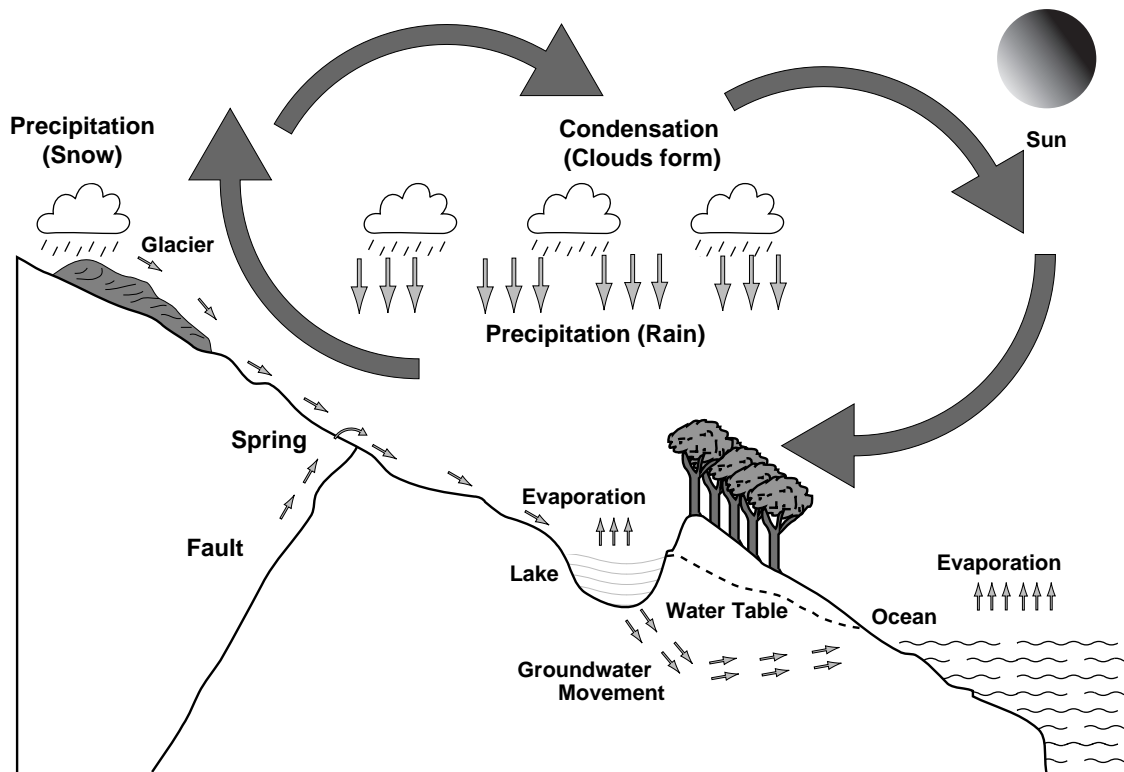
Water vapor is drawn into the atmosphere by changes in temperature. For example as warm air rises, it carries up water vapor. This water vapor can be transported hundreds of miles by air movement.

**Condensation** - When water vapors cool, they condense to form water droplets and clouds.

**Precipitation** - When clouds get too heavy they release precipitation in the form of rain, hail, sleet, or snow.

This water can flow into surface bodies of water, evaporate from the soil surface, be used by vegetation, or may continue to move downward to reach the groundwater. Water movement toward groundwater may take hours or years, depending on the depth to the aquifer and the characteristics of the soil.

Once in the ground, water flows downhill with the slope of the water table. Like surface water, groundwater flows toward, and eventually drains into streams, rivers, lakes and the oceans.



**Figure 10-4.** Water constantly moves through the three phases of the hydrologic cycle: evaporation, condensation, and precipitation.

## SOIL AND GROUNDWATER CONTAMINATION

Water moves—both on the surface and underground. This fact is important because it relates to how water and soil become contaminated. As water moves, its chemical composition reflects the material it has flowed through or over. For example, groundwater flowing through the subsurface area of a leaking underground storage tank (UST) will develop a chemical composition that includes water and dissolved petroleum products.

Having a basic understanding of water movement is important to understanding how water and soil becomes contaminated. As groundwater and surface water moves, its chemical composition begins to reflect where it has been, and the kind of material it has flowed through or over. For example, groundwater that flows through the subsurface area of a leaking UST tank will have a chemical composition of water and dissolved petroleum products.

Groundwater contamination is defined as a change in the chemical composition of groundwater. Although groundwater can be contaminated naturally, the largest contribution to contamination is the result of human activities. Contamination can occur from several man-made sources:

- Run-off, such as from junk yards, solid waste storage facilities, and landfills.
- Mining wastes.
- Deep-well disposal of liquid wastes.
- Seepage from industrial waste lagoons.
- Spills and leaks from industrial metal processing facilities (e.g., steel plants, plating shops).

The most common chemical *contaminants* found on hazardous waste sites are:

- |                        |                       |
|------------------------|-----------------------|
| • Acetone              | • 1,2-Dichloroethane  |
| • Aldrin/dieldrin      | • Lead                |
| • Arsenic              | • Mercury             |
| • Barium               | • Methylene chloride  |
| • Benzene              | • Naphthalene         |
| • 2-Butanone           | • Nickel              |
| • Cadmium              | • Pentachlorophenol   |
| • Carbon tetrachloride | • PCBs                |
| • Chlordane            | • Tetrachloroethylene |
| • Chloroform           | • Toluene             |
| • Chromium             | • Trichloroethylene   |
| • Cyanide              | • Vinyl Chloride      |
| • DDT, DDE, DDD        | • Xylene              |
| • 1,1-Dichloroethene   | • Zinc                |

<b>Contamination Sources</b>	<p>Although there are many contamination sources that threaten water quality, the major sources are categorized as either point sources or nonpoint sources.</p>
Point Source Contamination	<p>Point source contamination comes from water moving through or over waste from specific activities or waste management facilities. As wastes are slowly dissolved in the water, solutions are formed called <i>leachates</i>. Leachates percolate through the soil, moving down to the water table. Point sources include:</p> <ul style="list-style-type: none"><li>• Septic tank systems</li><li>• USTs</li><li>• Sanitary landfills</li><li>• Tailing piles and ponds for mining waste</li><li>• Chemical landfills</li><li>• Wastewater disposal ponds</li></ul>
Nonpoint Source Contamination	<p>Nonpoint source (<i>NPS</i>) contamination comes from water moving over and through the ground picking up widely dispersed natural as well as man-made pollutants, then depositing them in lakes, rivers, wetlands, coastal waters, and groundwater. NPS contaminants include:</p> <ul style="list-style-type: none"><li>• Excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas.</li><li>• Oil, grease, and toxic chemicals from urban runoff and energy production.</li><li>• Salt from irrigation practices.</li><li>• Acid drainage from abandoned mines.</li><li>• Bacteria and nutrients from livestock and pet wastes.</li></ul>
<b>Health and Environmental Risks</b>	<p>The risk to human health associated with contaminated soil and groundwater depends on the chemical contaminants and their concentrations. Among the many organic and inorganic chemicals that have been detected in groundwater are:</p> <ul style="list-style-type: none"><li>• Liver and kidney toxins</li><li>• Known or suspected carcinogens</li><li>• Chemicals capable of causing reproductive and central nervous systems damage</li></ul>

Contaminated soil and groundwater also pose an environmental risk when they discharge into surface bodies of water at sufficiently high concentrations. They contribute to fish kills, and have a negative effect on animal populations that drink the water. In addition, because many plants have a limited tolerance to specific metals and organics, groundwater contamination can have negative impacts on plant life and crop yields.

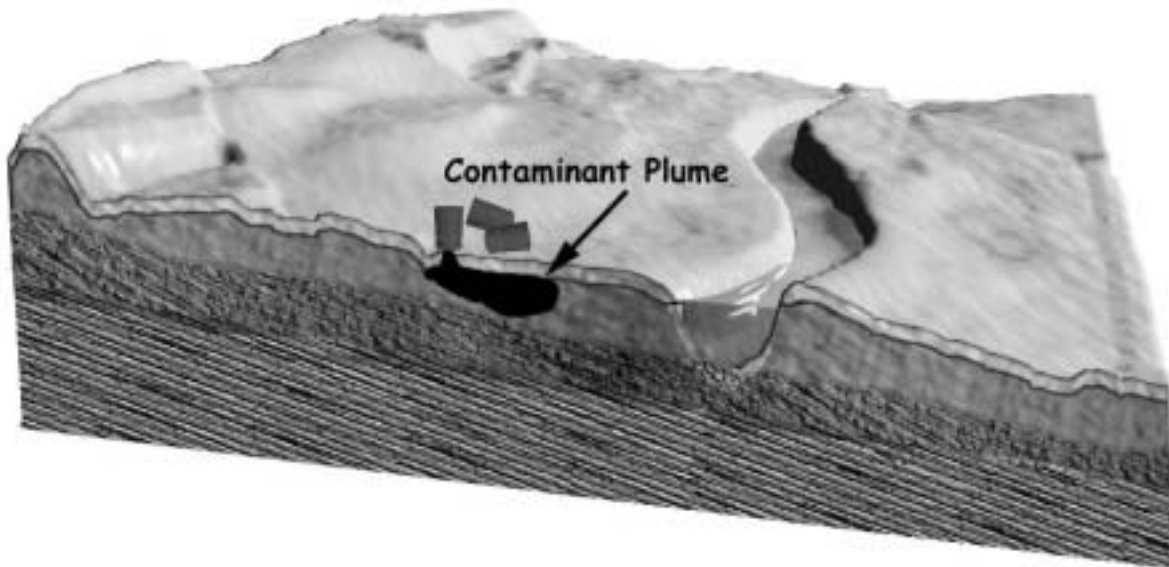
## **CONTAMINANT MIGRATION**

Contaminant migration is the movement of a contaminant after it enters the soil. Once a contaminant is introduced at or near the surface of the soil, it moves downward through the unsaturated soil toward the water table. As rainwater passes through the contaminated soil, it extracts water soluble compounds and particulate matter from the soil and forms a *leachate*. The area occupied by the leachate is referred to as a contaminant plume, and it will grow in size over time. (Figure 10-5).

The plume migrates (moves) through the groundwater, and eventually, will flow into streams, oceans, or other discharge points in the water cycle. More importantly, as the plume migrates, the contaminants can also be drawn into wells that supply drinking water.

What determines whether or not a chemical release will contaminate the groundwater? Three sets of factors influence how far and how fast a contaminant will move through the soil. They are:

1. Chemical properties of the contaminant
2. Physical properties of the soil
3. Site conditions



**Figure 10-5.** The area occupied by the leachate is referred to as a contaminant plume. It will grow in size over time.

### **Chemical Properties of Contaminant**

The chemical properties of the contaminant determine how it reacts to the environment, and how likely it is to reach and contaminate groundwater. These properties include solubility, volatility, and degradation.

#### **Solubility**

Solubility is the ability of one substance to dissolve in another substance. The more soluble a substance is, the more readily it dissolves. A contaminant that is water soluble will dissolve in groundwater and be moved through the soil.

#### **Volatility**

Volatility is the ability of a chemical to evaporate. The more volatile a chemical, the more easily it passes from a liquid to a vapor state. A highly volatile contaminant will tend to evaporate before it can be dissolved in the groundwater. (Small quantities of a volatile contaminant may also be dissolved in the groundwater, but they can be removed via thermal methods.)

#### **Degradation**

Degradation is the chemical breakdown of a substance in soil or water. The degradation of a chemical can be due to sunlight, soil microorganisms, and chemical and physical properties, such as a high pH.

**Soil Properties**

Soil properties also play a part in whether a chemical is likely to reach groundwater. These properties include texture, permeability, and organic matter content.

**Texture**

Soil texture is determined by the relative proportions of the sand, silt, and clay in the soil. Whether the soil is coarse, fine, or silty influences water movement through the soil. For example, coarse, sandy soil allows more water movement and has a lesser ability to adsorb chemicals than clay. The coarser the soil texture, the greater the chance a chemical will reach groundwater.

**Permeability**

Soil permeability is a measure of how fast water moves downward through soil. Highly permeable soils have a greater capability to lose chemicals to leaching. Applying pesticides or fertilizers to highly permeable soils should be done in such a way that leaching is kept to a minimum.

**Organic Matter**

Organic matter is made up of partially decomposed plant and animal matter such as leaves and grass. The amount of organic matter in the soil affects the ability of the soil to hold water and adsorb chemicals. In effect, organic matter acts like a sponge. The more organic matter, the more water the soil can hold. This decreases the downward movement of chemicals by leaching. Organic matter can also foster chemical and biologic reactions that can degrade contaminants.

**TREATMENT  
SELECTION**

A site investigation provides the necessary information to select an appropriate treatment technology for the site. Typically, selecting a treatment involves the following:

- Soil and groundwater sampling and analysis to characterize the nature and extent of site contamination.
- Risk assessment of current and potential future risks to human health and the environment posed by that contamination.
- Treatability studies to evaluate the potential costs and effectiveness of treatment or recovery technologies to reduce the toxicity, mobility, or volume of specific site waste.

**Corrective Actions**

If a site investigation shows a threat to human health and the environment, the following corrective measures must be taken:

- Prevent human and environmental exposure to contaminated groundwater that exceeds acceptable risks.
- Prevent or minimize further migration of the contaminant plume (plume containment).
- Prevent or minimize further migration of contaminants from source materials to groundwater (source control).
- Return the groundwater to its expected beneficial uses wherever practicable (aquifer restoration).

**Early Actions**

Early actions are taken when the Environmental Protection Agency (*EPA*) determines that a site may become a threat to human health or the environment in the near future. For example, a site with leaking drums of highly toxic substances could contaminate the water supply of a nearby city. In this type of situation, *EPA* would act quickly to make sure the problem is addressed and the site is safe. Early actions are taken to:

- Prevent direct human contact with the contaminants at the site.
- Remove hazardous materials from the site.
- Prevent contaminants from spreading off the site.
- Provide water to residents whose drinking water has been contaminated by the site.
- Temporarily or permanently evacuate/relocate nearby residents.

Early actions may take anywhere from a few days to five years to complete, depending on the type and extent of contamination. During this time, *EPA* also determines if long-term action will be necessary.

Two main factors for determining what activities are employed during the early action include:

1. Relative urgency posed by potential or actual exposure to contaminated groundwater (e.g., likelihood that contaminants will reach drinking water wells).
2. The degree to which an action will reduce site risks.

### **Source Removal**

When practical, the preferred method is to remove the contamination source(s) to a treatment and disposal facility. This involves using construction equipment, such as backhoes, bulldozers, and front loaders. Contamination sources and potential sources can be buried drums, USTs, or contaminated soil and water. Generally, source removal will only stop introduction of the contaminant from that source. Any contaminated soil and groundwater located around the well will remain contaminated until treated.

### **Surface Water Control**

Controlling surface water reduces the spread of contamination into uncontaminated regions. This method controls surface run-off and the contact of surface water with contaminants. Typical activities to control surface water include:

- Site contouring
- Capping - covering contaminated area with an impermeable cap
- Planting vegetation

### **Hydrodynamic Controls**

Hydrodynamic controls are complex. The process uses a tailored array of discharge and recharge wells to establish barriers within a groundwater body. For example, wells are used to prevent a contamination plume from intersecting a groundwater supply, such as a town well.

Using hydrodynamic controls involves a careful manipulation of the groundwater. Pumping wells change the direction of the groundwater. The cones of depression created around a pumping well act as a means for controlling the groundwater flow characteristics. This approach also is used to isolate a contamination plume, which can then be extracted and the contaminant removed or treated.

**Interceptor Systems**

Interceptor systems are similar to the drainage systems often used around the bottom of a building's foundation to prevent groundwater backup on the walls. The system is set up as follows:

1. Perforated pipe is laid in a trench cut a few feet below the water table around a waste site.
2. The pipe area is backfilled with gravel, and the trench filled in.
3. The pipe system is connected to a collection or storage facility that is either gravity fed (passive system) or pumped (active system).

An interceptor system is sometimes called a leachate collection system. For it to be effective, the water table must be relatively close to the surface.

**REMEDICATION TECHNOLOGIES**

Remediation technologies protect human health and the environment by either treating waste to reduce its volume and/or toxicity or by managing it to prevent it from spreading off-site. Generally, no single technology can remediate an entire site. Instead, several treatment technologies are combined to form a treatment train. For example, soil vapor extraction (*SVE*) can be integrated with groundwater pumping and air stripping to simultaneously remove contaminants from both groundwater and soil.

Remediation technologies employ one or more of the following strategies to remediate most sites:

- Destruction or alteration of contaminants
- Extraction or separation of contaminants
- Immobilization of contaminants

**DESTRUCTIVE TECHNOLOGIES**

Destructive technologies are treatment technologies that destroy a contaminant by altering its chemical structure. They can be applied *in situ* or *ex situ* to contaminated media. The most common destructive technologies include biological treatment and thermal treatment (incineration)

**Biological Treatment**

Bioremediation techniques stimulate microorganisms to grow and use contaminants as a food and energy source. Generally, this means providing some combination of oxygen, nutrients, and moisture, as well as controlling the temperature and pH. Microorganisms ultimately convert many organic contaminants to carbon dioxide, water, methane, cell mass, and trace amounts of hydrogen gas.

Biological treatment can usually be implemented at low cost. Contaminants can be destroyed with little to no residual treatment required. However, the process requires time, and it is difficult to determine whether contaminants have been destroyed. This type of treatment requires soil, aquifer, and contaminant characterization, and may require groundwater to be removed for treatment.

Bioremediation has been successfully used to remediate soils, sludges, and groundwater contaminated by petroleum hydrocarbons, solvents, pesticides, wood preservatives, and other organic chemicals. It is not suitable for treatment of inorganic contaminants.

**Safety and Health Hazards**

Little information is available on potential safety and health problems associated with biological treatment. However, be aware of the hazards associated with the removal and transportation of contaminated material, and:

- Be sure to use proper personal hygiene.
- Be aware that some compounds may be broken down into more toxic by-products during the bioremediation process. For example trichloroethylene (*TCE*) breaks down into vinyl chloride.

**Incineration**

Incineration involves burning hazardous wastes to destroy organic compounds, such as dioxins and polychlorinated biphenyls (PCBs). Incinerators can handle many forms of waste, including contaminated soils, sludges, solids, and liquids. However, it is not effective in treating inorganic substances such as hydrochloric acid, salts, and metals.

The EPA issues permits that establish and specify the conditions under which each incinerator can operate. A permit defines how the incinerator must operate, such as:

- Maximum carbon monoxide level in stack gases (gases from the combustion process that exit the stack after being treated for air pollution).
- Maximum feed rates (how fast hazardous wastes are fed into the incinerator).
- Minimum burning temperature.

The permit conditions are designed to deliver a complete burn of the hazardous waste. For example, a permit requires the waste feed to be cut off if burning conditions are not optimal.

#### Why is it Used?

Incineration can be a permanent waste disposal solution because it destroys wastes that would otherwise take up space in a landfill. Incineration effectively destroys more than 99 percent of all organic compounds.

A common misconception is that the more toxic a chemical, the more difficult it is to burn. EPA's research shows that the toxicity level of a chemical does not relate to how easily it breaks down during incineration.

No incinerator can destroy 100 percent of the hazardous waste fed into it. There are always small amounts of waste released into the atmosphere through the incinerator stack or mixed with the ash. EPA requires that each incinerator destroys and removes 99.99 percent of all hazardous waste it processes. For PCBs and dioxin wastes, the standard is 99.999 percent. When operated properly, incinerators can meet or exceed these standards. However, operating at this efficiency level is a complex, highly technical task.

#### How Does it Work?

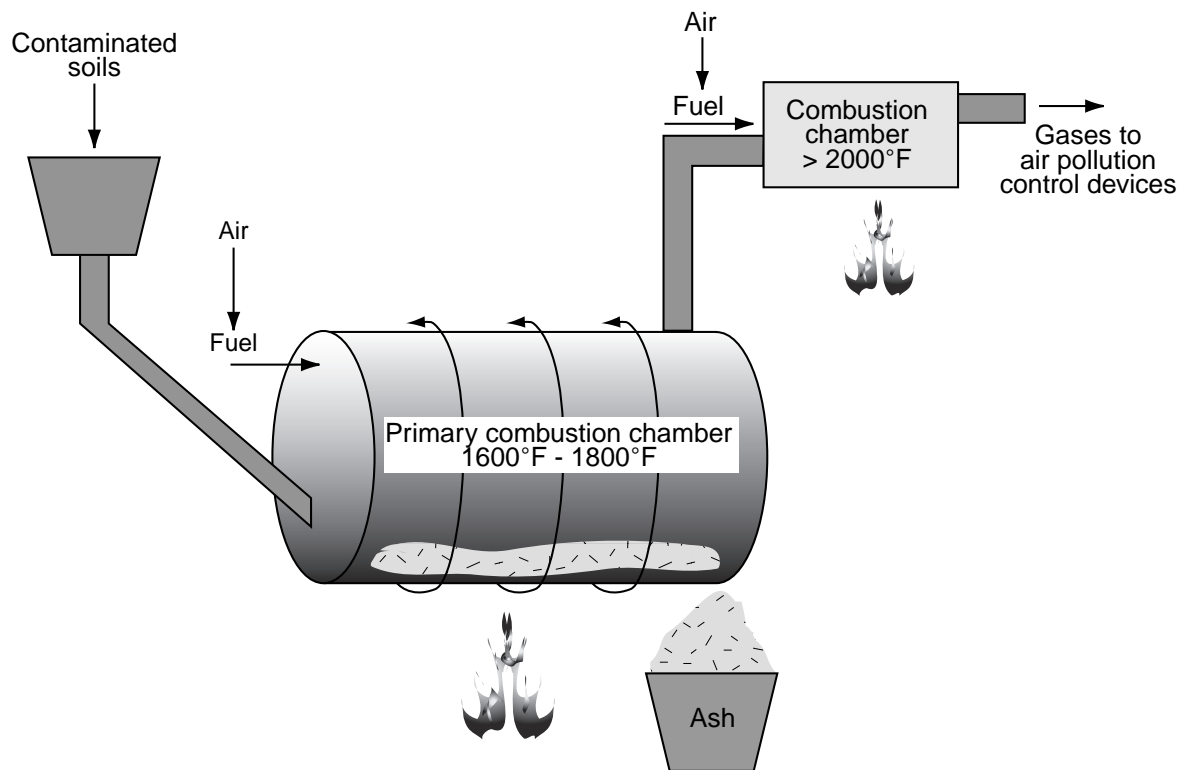
Incineration uses temperatures between 1600°F (871°C) and 2500°F (1371°C) to degrade contaminants into nontoxic substances, such as water, carbon dioxide, and nitrogen oxides (nitrogen and oxygen). Properly done,

high-temperature incineration can be an effective, odorless, and smokeless process. The process is illustrated in Figure 10-6.

### Safety and Health Hazards

Thermal remediation techniques present a number of special safety and health hazards to you as a hazardous waste worker, including:

- Burns
- Electrical hazards
- Exposure to concentrated gases and vapors
- Falls
- Fires and explosions
- Heat stress
- Ladders and small platforms on the equipment
- Mechanical equipment, such as conveyors
- Soil moving equipment, such as hoppers and loaders



**Figure 10-6.** Incineration uses temperatures between 1600°F (871°C) and 2500°F (1371°C) to breakdown contaminants into nontoxic substances

**EXTRACTION AND SEPARATION TECHNOLOGIES**

Extraction and separation remediation technologies remove contaminants from the soil or groundwater by heating, washing, adsorption, and stripping. They use the physical and chemical properties of a contaminant to separate and extract it from the soil or groundwater. Extraction technologies are the most common methods used to clean contaminated sites and include:

- Soil vapor extraction
- Air sparging
- Soil washing
- Thermal desorption

**Soil Vapor Extraction**

Soil vapor extraction (SVE) is an in situ method that reduces concentrations of volatile contaminants in the soil. Also known as soil venting or vacuum extraction, SVE is the most frequently selected remediation technology for treating contaminated soil at Superfund sites.

**How Does SVE Work?**

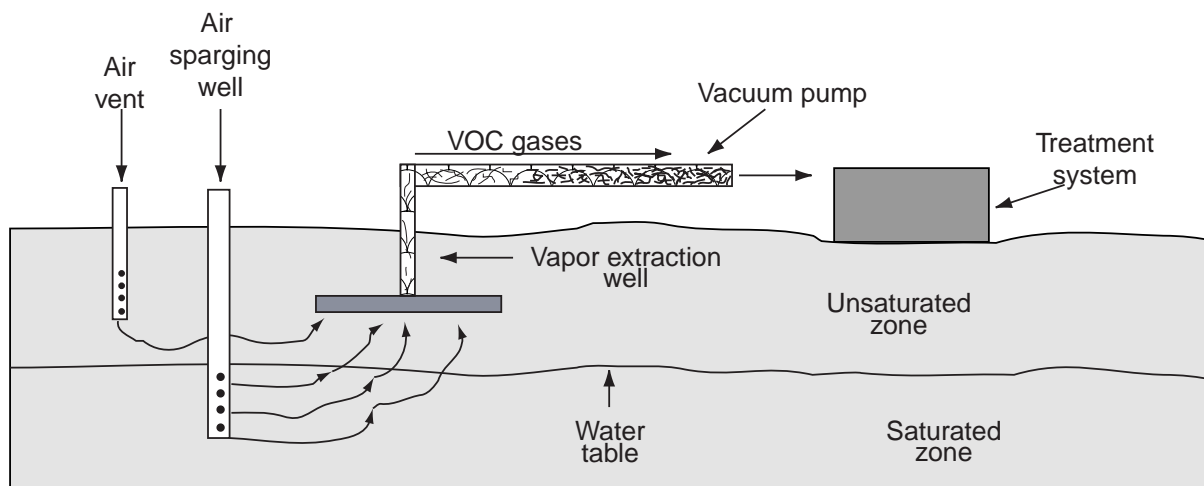
The basic SVE system consists of one or more vapor extraction wells and injection wells (or air vents) placed in the contaminated area. Air injection wells use air compressors to force air into the ground. Air vents serve the same function as air injection wells, but are passive—instead of pumping air they just provide a passage for air to be drawn into the ground.

The process is illustrated in Figure 10-7 and works as follows:

1. Incoming air passes through the soil on its way to the extraction wells.
2. Volatile organic compounds (VOCs) evaporate out of the spaces between the soil particles.
3. The contaminated vapors are pulled along by the air to the extraction wells and removed.

Vapor extraction wells can be placed either vertically or horizontally. Typically, they are placed vertically and are designed to penetrate the lower portion of the unsaturated zone. Vapors extracted by the SVE process are typically treated using carbon adsorption, incineration, or condensation.

SVE performance can be enhanced or improved by injecting heated air or steam into the contaminated soil through the injection wells. The heated air or steam helps to "loosen" some less volatile compounds from the soil. (Heat increases evaporation with some chemicals.)



**Figure 10-7.** The soil vapor extraction process introduces air into the contaminated soil and causes volatile organic compounds to evaporate out of the soil.

**Air Sparging**

SVE alone cannot remove contaminants in the saturated zone. At sites where contamination is in the saturated zone, a process called air sparging may be used along with the SVE system. The air sparging process pumps air into the saturated zone to help flush (bubble) the contaminants into the unsaturated zone where the SVE extraction wells can remove them.

For air sparging to be successful, the soil in the saturated zone must be loose enough to allow the injected air to readily escape up into the unsaturated zone. Air sparging, therefore, will work fastest at sites with coarse-grained soil, such as sand and gravel.

As an added benefit, both SVE and air sparging provide an oxygen source for microorganisms in the soil. The oxygen stimulates the bioremediation process that breaks down some contaminants.

**Soil Washing**

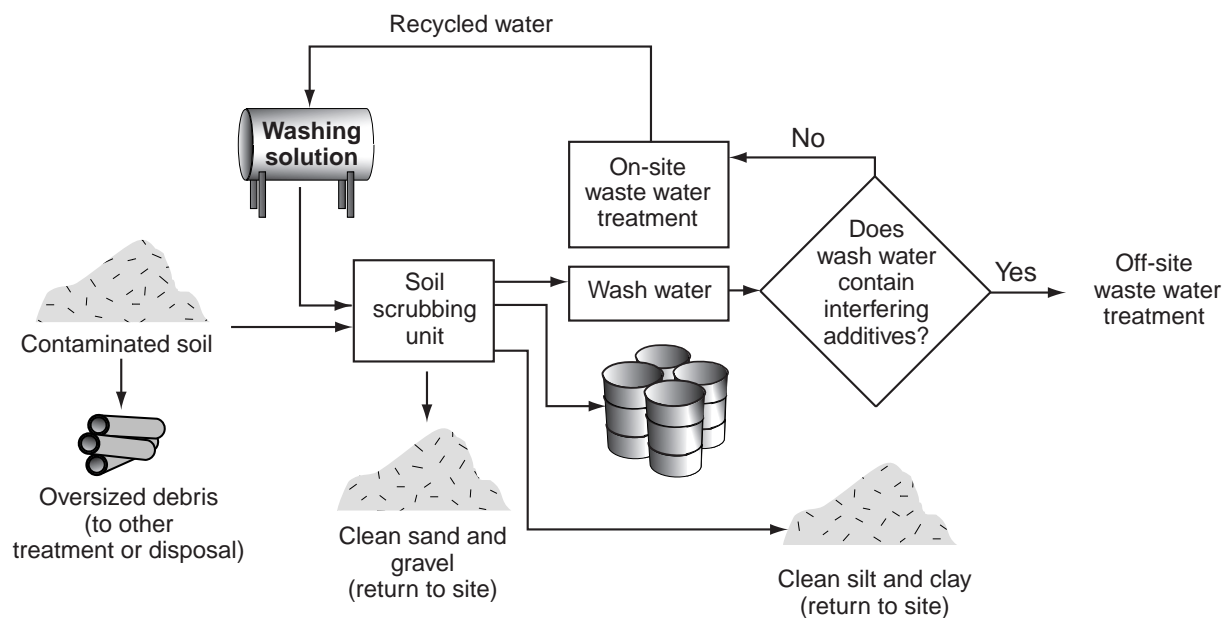
Soil washing is a technology that uses liquids (usually water, sometimes combined with chemical additives or solvents) and a mechanical process to scrub soils. This scrubbing removes hazardous contaminants and concentrates them into a smaller volume.

Hazardous contaminants tend to bind, chemically or physically, to silt and clay. Silt and clay, in turn, bind to sand and gravel particles. The soil washing process separates the contaminated fine soil (silt and clay) from the coarse soil (sand and gravel). When completed, the smaller volume of soil will contain the majority of the fine silt and clay particles. This soil can be further treated by other methods, such as incineration or bioremediation, or disposed of according to state and federal regulations. The clean, larger volume of soil is nontoxic and can be used as backfill.

### How Does Soil Washing Work?

A simplified drawing of the soil washing process is illustrated in Figure 10-8. The equipment is transportable so that the process can be conducted at the site. It works as follows:

1. The contaminated soil is dug up and moved to a staging area, where it is prepared for treatment.
2. The soil is sifted to remove debris and large objects, such as rocks.
3. The sifted soil enters a soil scrubbing unit, in which the soil is mixed with a washing solution and agitated.
4. The washing solution removes the contaminants from the soil. The solution may be water or contain additives such as detergent. This process is very similar to washing laundry.
5. The wash water is drained out of the soil scrubbing unit, and the soil is rinsed with clean water.



**Figure 10-8.** During the soil washing process contaminated soil is mixed with a washing solution to remove contaminants.

The larger scale soil washing equipment presently in use can process over 100 cubic yards of soil per day. The heavier sand and gravel particles in the processed soil settle out and are tested for contaminants. If clean, this material can be used on the site or taken elsewhere for backfill. If traces of contaminants are still present, the material may be run through the soil washer again or collected for alternate treatment or off-site disposal. Off-site disposal may be regulated by either the Resource Conservation Recovery Act (*RCRA*) or the Toxic Substance Control Act (*TSCA*).

The wash water, which now also contains contaminants, is treated by wastewater treatment processes so it can be recycled for further use. As mentioned earlier, the wash water may contain additives, some of which may interfere with the wastewater treatment process. If this is the case, the additives must be removed or neutralized by pretreatment methods before the wash water goes to wastewater treatment.

Once separated from the wash water, the silt and clay are tested for contaminants. If the silt and clay are clean, they can be used at the site or taken elsewhere for use as backfill. If the silt and clay are still contaminated, they may go through the soil washing process again or be collected for alternate treatment or off-site disposal in a permitted RCRA or TSCA landfill.

### **Thermal Desorption**

Thermal desorption is also known as low-temperature thermal volatilization, thermal stripping, and soil roasting. This technology uses heat to physically separate VOCs, such as gasoline, solvents, and petroleum hydrocarbons, from excavated soils. Thermal desorbers are designed to heat soils to temperatures between 300°F to 1000°F (149°C to 538°C) to cause contaminants to volatilize and desorb (physically separate) from the soil.

Thermal desorption is effective at separating organics from refining wastes, coal tar wastes, waste from wood treatment, and paint wastes. It can separate solvents, pesticides, PCBs, dioxins, and fuel oils from contaminated soil. The equipment available is capable of

treating up to 10 tons of contaminated soil per hour. Finally, the lower temperatures require less fuel than other treatment methods.

Although they are not designed to decompose contaminants, thermal desorbers can be used for partial decomposition under certain conditions. Their use depends upon the specific organics present and the temperature of the desorber system.

Prior to discharge to the atmosphere, vaporized VOCs are generally treated in a secondary treatment unit, such as:

- Afterburner
- Carbon adsorption unit
- Catalytic oxidation chamber
- Condenser

Afterburners and oxidizers destroy the contaminants. Condensers and carbon adsorption units trap organic compounds for further treatment or disposal.

#### How Does Thermal Desorption Work?

Thermal desorption works as follows:

1. Contaminated soil is placed in a rotating drum, which is sealed and heated indirectly.
2. As the material travels the length of the drum, it is aerated and agitated, then discharged.
3. During the treatment process, hydrocarbon contaminants are changed into gases and routed to a condensing unit.
4. Gases are either recondensed or thermally destroyed.

Usually, the gases are recondensed. For soil with low levels of contamination, in which reclaiming is not required, the gases can be thermally destroyed. Examples include soil from abandoned service stations or tank batteries.

**Safety and Health Hazards**

Thermal remediation techniques present a number of special safety and health hazards including:

- Burns
- Electrical hazards
- Exposure to concentrated gases and vapors
- Falls
- Fire/explosion
- Heat stress
- Ladders and small platforms on the equipment
- Mechanical equipment, such as conveyors
- Soil moving equipment, such as hoppers and loaders

Thermal desorption systems are basically small, often portable, chemical plants that are set up on the hazardous waste site. A chemical plant environment is much different than the construction site so you need to be especially alert when working around these systems.

**IMMOBILIZATION**

Immobilization or isolation technologies attempt to prevent the movement of contaminants by containing them within a designated area. These technologies can be used to prevent further contamination of soil and groundwater when other treatment options are not physically or economically feasible for a site.

Immobilization technologies include the following:

- Solidification and stabilization
- Slurry trenches and walls
- Vitrification

**Solidification and Stabilization**

Solidification and stabilization technologies use both physical and chemical means. Solidification encapsulates the contaminant. Stabilization physically alters or binds with the contaminant. The goal is to stop further migration of contaminants.

**Slurry Trenches and Walls**

Slurry trenches are vertical barriers with low permeability. They are constructed in the ground to reduce the movement of contaminants. The terms “slurry trench” and “slurry wall” are used

interchangeably here. However, a slurry wall implies a more permanent structure that may stand on its own when the soil around it is partially excavated.

Slurry trenches are commonly used as:

- Perimeter containment structure to temporarily immobilize contamination (Figure 10-9a)
- Groundwater barrier upgradient from contamination to reduce the spreading of the plume (Figure 10-9b).

Slurry trenches are not usually designed for permanent retention. They are temporary barriers that prevent waste from spreading through the groundwater during cleanup. These structures can greatly increase the efficiency of a pump and treat system by reducing the volume of water that will enter the wells. Typically the trenches are keyed into a confining layer such as clay or bedrock to prevent migration of contaminants under the trench.

Slurry walls are placed upgradient of the waste to redirect the groundwater around the contaminant, reducing its spreading. The groundwater flow is locally reduced, and this also assists in recovering any plume that has moved downgradient from the site.

Slurry walls are also used downgradient from a plume to increase the effectiveness of a pump and treat system (Figure 10-9c). Downgradient slurry walls circumvent the entire spill to prevent movement of the plume. However, clean groundwater is allowed to flow into the site, which helps to flush the waste into the pumping wells.

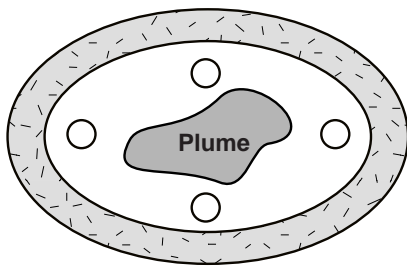


Fig. 10-9a

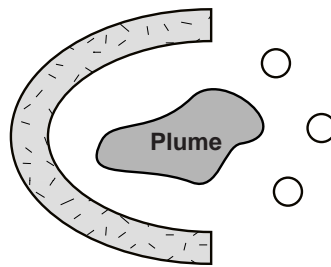


Fig. 10-9b

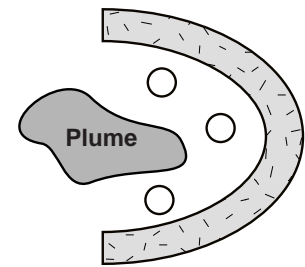


Fig. 10-9c

**Figure 10-9(a-c).** Slurry trenches are used to immobilize contaminants as well as to reduce the spread of a contaminant plume.

## Construction

Slurry walls come in different types and are commonly used for various reasons. This discussion will focus on soil-bentonite slurry walls, which are by far the most common type used for remediation of hazardous waste sites. Other wall types include:

- Cement-bentonite
- Lean or plastic concrete
- Vibrating beam

Soil-bentonite slurry walls are constructed by excavating a trench with a backhoe or a clamshell. The trench is kept open by filling it with a bentonite-water slurry, which prevents the native soil from caving into the excavation. The slurry level must be kept above the water table to provide enough support for the sides of the trench. As the excavation progresses, a soil-bentonite backfill is placed in the trench, displacing the bentonite-water slurry.

## Vitrification

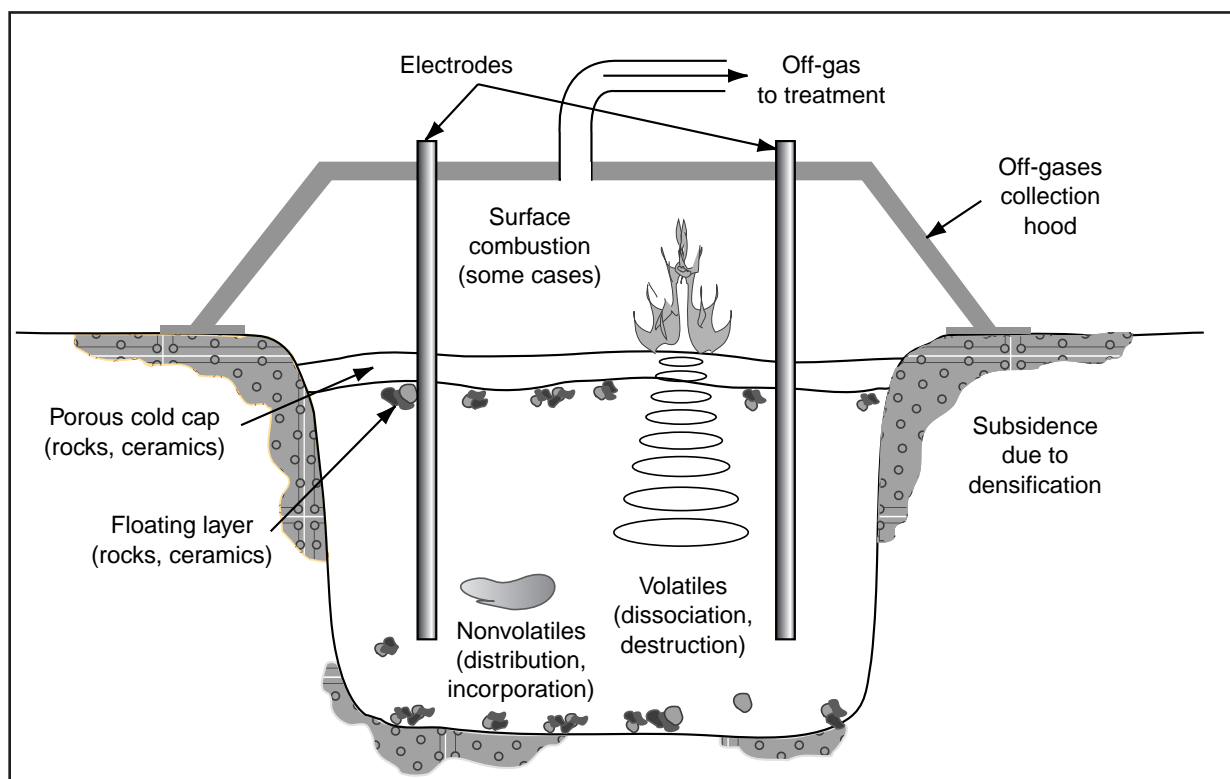
Vitrification is a process that uses electrical power to heat and melt contaminated soil into a hard, chemically inert, stable glass and crystalline material. Organic contaminants within the soil are vaporized and destroyed or captured in an off-gas treatment system. Metals and radionuclides are contained in the glassy material.

## How Does it Work?

Vitrification works as follows:

1. A system of electrodes is inserted into the ground to the desired treatment depth.
2. Electrical current is delivered through the soil by the electrodes to heat the soil to 2,000°C (1093°C). This temperature is well above the melting temperature of typical soils.
3. The molten mass grows downward and outward until the melt zone reaches the desired depth and width.
4. The process is repeated in square arrays until the desired volume of soil has been vitrified.

With ideal site conditions, it is estimated that a processing depth of up to 30 feet (9.2 meters) can be achieved. Figure 10-10 illustrates the components of vitrification.



**Figure 10-10.** Vitrification is a solidification method that uses electrodes to melt contaminated soil to keep it in place.

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**SECTION 10 - ASSIGNMENT SHEET**

1. List the two categories of major sources of groundwater contamination and give three examples of each source.

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2. List the three factors that influence how fast and how far a contaminant will move through the soil.

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3. Define the following terms:

Contaminant plume

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Groundwater

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Leachate

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Solubility

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Volatility

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4. Identify the three strategies used by the various remediation technologies and give two examples of each strategy.

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5. List the health and safety hazards of thermal desorption, biological treatment and incineration.

Thermal desorption

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Biological treatment

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Incineration

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## HAZARDOUS WASTE WORKER

Section

**11**

Title

**LEGAL RIGHTS**

### TRAINEE OBJECTIVES

After completing Section 11, you will be able to:

1. List the 17 paragraphs of the OSHA Hazardous Waste Operations and Emergency Response standard.
2. List the seven employee responsibilities given in the Occupational Safety and Health ACT (OSH Act).
3. List the 11 rights an employee has under Section 11(c) of the OSH Act.
4. List three conditions found in 29 CFR 1977.12 that must be present for OSHA's "right to refuse hazardous work" to apply.
5. Locate answers to questions using the OSHA Hazardous Waste Operations standard (29 CFR 1910.120).
6. Match environmental protection laws with the correct definition.



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**PART A****INTRODUCTION**

Workers on hazardous waste clean-up sites need specialized knowledge and training in order to work safely in a hazardous environment. Part of that knowledge includes a basic understanding of the laws and regulations that give workers important legal rights.

The most important worker safety protections come from the Occupational Safety and Health Act (*OSH Act*) and the various Occupational Safety and Health Administration (*OSHA*) safety standards. This section will focus on the following topics:

- Legal protections provided by the OSH Act and the OSHA Hazardous Waste Operations Safety Standard.
- Environmental laws.
- Safety and health information for workers employed by Department of Energy contractors.
- Safety and health protections for government workers at the federal, state, and local levels.

Safety and health laws and regulations are quite complicated. This section provides a simplified, easy-to-read reference source for workers in the hazardous waste industry. The information provided is a good starting point for understanding basic legal rights; however, this material cannot anticipate the many different situations that may arise on a site. These materials cannot substitute for individualized, situation-specific legal advice if a serious dispute arises on the job.

**VIDEO SEGMENT 1****OCCUPATIONAL  
SAFETY AND  
HEALTH ACT**

The OSH Act of 1970 is the most significant law protecting health and safety in the workplace. Although most of the major responsibilities under the law are assigned to the employers, the OSH Act imposes duties both on employers and employees.

The employer responsibilities are found in Section 5(a) of the Act. The law imposes very broad obligations on employers:

Duties of employers and employees  
Sec. 5(a) Each employer:

- (1) Shall furnish to each of his employees . . . a place of employment which [is] free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;
- (2) Shall comply with occupational safety and health standards promulgated under this Act.

Basically, this section of the law imposes two requirements on employers.

The second clause of Section 5(a) requires employers to comply with all the OSHA standards that are issued by OSHA, a division of the U.S. Department of Labor. Since 1970, OSHA has published thousands of pages of regulations establishing safety standards for different industries (construction, shipbuilding, general industry, logging, etc.), tools, and equipment (ladders, forklifts, scaffolding, personal protective equipment), work processes (welding, commercial diving, materials handling), specific hazardous materials (compressed gases, oxygen, blasting agents, ammonia), medical recordkeeping, first aid, fire protection, electrical standards, etc. Employers have a specific duty to comply with OSHA safety standards.

Even though OSHA has published many special safety and health standards, the rules never can anticipate all the hazards that may be present at every workplace. Thus, in addition to holding employers responsible for complying with the **specific** OSHA standards, the first clause of this section—5(a)(1)—also imposes a **general** duty on employers to provide a workplace free from recognized hazards. In other words, regardless of whether there is a published OSHA standard that covers a particular problem on the job site, the employer has an obligation to try to eliminate from the workplace any hazard that is likely to cause death or serious physical harm to workers.

The responsibilities of employees are included in the same Section 5 of the OSH Act:

Sec. 5(b) Each employee shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to this Act which are applicable to his own actions and conduct.

In other words, the law recognizes that employees also play an essential role in making the job site a safe place to work. It is very important that workers, too, comply with the OSHA regulations that have been issued to protect them.

**Hazardous Waste  
Operations and  
Emergency Response  
29 CFR 1910.120**

The OSH Act gives the Labor Department the responsibility for adopting safety and health regulations to protect workers. However, by the mid-1980s there still were no regulations governing work at hazardous waste sites. As the nation's cleanup effort was getting under way, the absence of a safety standard for the remediation industry was becoming a significant problem as increasing numbers of workers began to handle hazardous waste materials.

In 1986, Congress recognized the hazards that confronted workers during clean-up operations. When amending the Superfund law by enacting the Superfund Amendment and Reauthorization Act (SARA), Congress specifically instructed the Department of Labor to develop safety and health rules for hazardous waste operations. The final OSHA standard for Hazardous Waste Operations and Emergency Response was adopted in 1989, and was codified in volume 29 of the Code of Federal Regulations (CFR) as 1910.120. The regulation often is called the OSHA Hazwoper Standard. The Code of Federal Regulations includes the regulations that are issued by federal agencies.

For workers in the hazardous waste and environmental remediation industry, the OSHA standard is an important document that establishes basic operational guidelines for employers and employees. This segment of the lesson first provides a general overview of the standard, followed by a detailed look at the standard's

training and medical surveillance requirements. The Hazardous Waste Operations and Emergency Response Standard is found in Appendix C of this manual.

## Overview

Like many government regulations that address complex problems, the Hazwoper Standard is relatively long and detailed. In order to find specific information, it is helpful to be familiar with the general structure of the standard.

The 17 paragraphs of the Hazardous Waste Operations and Emergency Response Standard are:

- (a) Scope, application, and definitions
- (b) Safety and health program
- (c) Site characterization and analysis
- (d) Site control
- (e) Training
- (f) Medical surveillance
- (g) Engineering controls, work practices, and personal protective equipment for employee protection
- (h) Monitoring
- (i) Informational programs
- (j) Handling drums and containers
- (k) Decontamination procedures
- (l) Emergency response by employees at uncontrolled hazardous waste sites
- (m) Illumination
- (n) Sanitation at temporary workplaces
- (o) New technology program
- (p) Certain operations conducted under the Resource Conservation and Recovery Act of 1976 (RCRA)
- (q) Emergency response to hazardous substance releases

The following section is a brief summary of the material in each of the major paragraphs of the standard.

(a) *Scope, application, and definitions*—Paragraph (a) of the standard identifies the regulation's scope and application, and includes definitions of special terms.

The Hazwoper standard's scope covers several different types of work situations. Most of the regulation is designed around environmental cleanup activities under the Superfund law, the Comprehensive Environmental

Response, Compensation, and Liability Act (CERCLA). Cleanup sites sometimes are referred to as “uncontrolled hazardous waste sites” because they deal with hazardous materials that were released into the environment at some time in the past. However, in addition to cleanup sites, the regulation also sets safety standards that protect workers at hazardous waste “treatment, storage, and disposal (TSD) facilities” regulated under the Resource Conservation and Recovery Act (RCRA), and also covers workers involved in emergency response to releases and spills (including police, fire fighters, and Hazmat crews).

The definitions portion of Paragraph (a) explains some of the terms used in the Hazwoper Standard, including the “Buddy system,” “Decontamination,” “IDLH,” “Qualified person,” “Site safety and health supervisor,” and many others. The definitions follow the following format:

*“Site safety and health officer (or official)”* means the individual located on a hazardous waste site who is responsible to the employer and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements.

*(b) Safety and health program.* Each employer whose workers are involved with hazardous waste materials is required to develop and implement a written safety and health program. The written program must be made available to employees, subcontractors, and union representatives.

In addition to describing the employer’s general organizational structure (that is, which contractor personnel are responsible for implementing the safety and health program), the employer’s safety and health program must include site-specific information such as a comprehensive work plan for the site and a site-specific safety and health plan, which shall be kept on site.

At a minimum, the site-specific plan must address:

- Risk or hazard assessment
- Training assignments
- PPE to be used at the site
- Medical surveillance
- Air monitoring and sampling program
- Site control measures
- Decontamination procedures
- Emergency response plan
- Confined space entry procedures

Employers must give all workers a “pre-entry briefing” before they begin work at the site, to make sure that the employees are aware of the safety and health plan. The site safety and health plan should be updated by the employer periodically as new information is obtained about job site conditions, or if weaknesses in the plan are detected.

*(c) Site characterization and analysis.* The OSHA standard requires that hazardous waste sites be evaluated by contractors to identify specific site hazards, and to determine the appropriate safety and health control procedures needed to protect employees from the identified hazards. This process generally involves monitoring, sampling, and risk assessment that is performed before work at the site begins. Hazardous waste workers must be informed by the contractor of any site hazards that are identified.

*(d) Site Control.* Employers must implement site control procedures before clean-up work begins. Site control programs must include, at a minimum:

- Site map
- Site work zones
- Buddy system
- Site communications, including emergency alerting means
- Standard operating procedures or safe work practices
- Identification of the nearest medical assistance

(e) *Training.* All employees working on site who may be exposed to hazardous substances, health hazards, or safety hazards must be trained in accordance with the OSHA Hazwoper standard. (Training requirements are reviewed in detail later in the section.)

(f) *Medical surveillance.* Employers engaged in hazardous waste operations must institute a medical surveillance program for their employees. (Medical surveillance requirements are reviewed below.)

(g) *Engineering controls, work practices, and personal protective equipment for employee protection.* Under the OSHA standard, employers must take steps to minimize the possibility that employees will be exposed to hazardous materials. Where possible, engineering controls and work practices must be instituted to reduce possible employee exposures to levels below the permissible exposure limits (*PELs*). If it is not possible to achieve exposure levels below the *PELs* through engineering controls and work practices, these measures shall be used in combination with appropriate personal protective equipment (*PPE*).

(h) *Monitoring.* Employers must implement a monitoring program if there is a possibility of employee exposure to hazardous concentrations of hazardous substances. Air monitoring shall be conducted prior to initial entry at the site, to identify Immediately Dangerous to Life and Health (*IDLH*) conditions, concentrations above the *PEL*, radiation exposures over allowed dose limits, or the presence of flammable atmospheres or oxygen-deficient locations.

Additional periodic monitoring is performed as site conditions change, such as the beginning of work on a new section of the site, or when there is a change in the materials being handled by the workers. During site cleanup, employers periodically should conduct personal sampling of the workers who are likely to have the highest exposures to substances that may be present above the *PELs*.

(i) *Informational programs.* Employers must have a program for informing employees, contractors, and subcontractors (or their representatives) actually engaged in hazardous waste operations of the nature and degree of likely exposure.

(j) *Handling drums and containers.* The OSHA standard includes a series of specific rules detailing how drums and other containers holding hazardous substances and contaminated soils, liquids, and other residues shall be handled, transported, labeled, and disposed of.

(k) *Decontamination.* Decontamination procedures must be developed for employees, clothing, and equipment in accordance with the OSHA regulation.

(l) *Emergency response by employees at uncontrolled hazardous waste sites.* A written emergency response plan shall be developed by employers, and made available to employees, union representatives, and government officials. At a minimum, emergency response plans must address:

- Pre-emergency planning
- Personnel roles, lines of authority, and communication
- Emergency recognition and prevention
- Safe distances and places of refuge
- Site security and control
- Evacuation routes and procedures
- Decontamination procedures that are not covered by the site safety and health plan
- Emergency medical treatment and first aid
- Emergency alerting and response procedures
- Critique of response and follow-up
- PPE and emergency equipment

(m) *Illumination.* The OSHA Hazwoper standard includes a table specifying minimum lighting levels for various work areas at hazardous waste sites.

(n) *Sanitation at temporary workplaces.* Employers must provide an adequate supply of potable water; i.e., water that is safe for drinking, washing, or cooking. The

standard includes minimum specifications for the number and type of toilet facilities at the site, as well as washing facilities, showers, and changing rooms.

*(o) New technology programs.* The OSHA standard requires employers to introduce new technologies and equipment to the hazardous waste cleanup site if the technologies are effective in improving the health and safety protection of employees. The new technology program also must examine technology, equipment, and control measures that will minimize the level of air contaminants during excavation or for spill control.

*(p) Certain operations conducted under the Resource Conservation and Recovery Act (RCRA) of 1976.* A separate paragraph addresses requirements for employers operating “treatment, storage, and disposal” (TSD) facilities where hazardous waste materials are processed or stored. These facilities, which include incineration operations, special hazardous waste burial sites, and other long- or short-term storage facilities, are regulated under RCRA.

Unlike uncontrolled hazardous waste sites, where contractors often have a difficult time determining the hazards confronting their employees, the hazardous materials that are shipped to TSD facilities typically have been analyzed extensively, packaged, and labeled. The risks to employees from handling these materials, therefore, are slightly different from the hazards found at cleanup sites.

Paragraph (p) of the Hazwoper standard contains specific rules for employers at TSD facilities. Generally, these requirements are very similar to the rules that govern employers at “uncontrolled” cleanup sites, including safety and health programs, training, medical surveillance, emergency response, etc.

*(q) Emergency response to hazardous substance releases.* Paragraph (q) of the Hazwoper standard covers employees involved with hazardous materials emergency response at sites other than environmental cleanup jobs and TSD sites. Basically, this paragraph covers

employees who play some role in responding to hazardous substance spills, explosions, fires, etc. This includes police, fire fighters, HAZMAT teams, and post-emergency response (clean-up) crews.

The emergency response requirements are specialized, calling for the creation of an Incident Command System capable of coordinating the response activity. Increasing levels of training are required for persons categorized as “first responder awareness level,” “first responder operations level,” “hazardous materials technician,” “hazardous materials specialist,” and “on scene incident commander.” The standard mandates a medical surveillance program and PPE requirements.

## **TRAINING REQUIREMENTS**

Worker training is a central part of the OSHA Hazwoper standards. When developing the regulations, OSHA recognized that providing employees with knowledge would be critical to achieving a safer work environment.

Under the OSHA standard, employers must be certain that all workers whose jobs may involve exposure to hazardous materials receive both general training to prepare them for work in the industry, as well as site-specific training that addresses the requirements of the specific job site. See Appendix C - 1910.120(e) at the back of this manual for the specific text.

The training program outlined in 1910.120(e) does not have to be written. The absence of a written training program does not, by itself, constitute a violation of the OSHA standard. However, 29 CFR 1910.120(i)(2) requires a written safety and health plan that covers “employee training assignments”. In addition, any employer who is not able to show by a certificate or list that his or her employee is trained or has equivalent training [see 1910.120 (e)(9)] will not be permitted to engage that employee in hazardous waste clean-up operations covered by the OSHA regulations.

The training requirements of Paragraph (e) also require at least 24 hours of initial training for workers who are on the site only occasionally for limited tasks that are not

likely to be exposed, and for employees who work entirely in areas that have been fully characterized and where exposure levels are below the PELs.

Employees who are not at all exposed nor potentially exposed to hazardous waste or hazardous substances do not have to meet the training requirements. If exposure is present or likely to occur, the employer must require that these workers be trained.

### Certification Requirements

The OSHA standard requires that employees be certified:

Employees and supervisors that have received and successfully completed the training and field experience . . . shall be certified by their instructor and training supervisor as having successfully completed the necessary training. A written certificate shall be given to each person so certified.

The Hazardous Waste Operations Standard does not specify what type of certification is necessary to show that employees have completed the necessary training. Examples include, but are not limited to, a roster of classroom attendance, diploma, wallet card, or an entry into a personnel folder. The written documents must identify the employee, the person certifying, the certifier's qualifications, and some indication of the time in training and the subject matter covered.

Proposed regulations on certification are now under consideration as 29 CFR 1910.121. Laborers-AGC has proposed more strict certification requirements, including the approval of the training program sponsor, the curriculum of the training, and the trainers. In addition, the trainee will have to take an objective examination and be certified by OSHA or by the OSHA delegate such as the Training Fund.

**MEDICAL  
SURVEILLANCE  
REQUIREMENTS**

Regular monitoring of employee health is an important part of the hazardous waste industry. By establishing a medical “baseline” for each employee, and then regularly checking the employee’s health, it may be possible to spot any health problems that develop early.

The OSHA standard 1920.120(f) includes a very strong requirement that employers institute medical surveillance programs. These programs must include medical check-ups conducted under the supervision of doctors knowledgeable about occupational illnesses. The regulation requires that the program must be available at no cost to the worker, and that the medical professional take steps to insure that an employee’s right to confidentiality is protected in the event that non-work-related illnesses are detected by the testing. (See Appendix C 1920.120(f) at the end of this manual for the specific text.)

Although the hazardous waste safety standard has broad application, it should be noted that there are some limitations to OSHA’s jurisdiction. For example, if another Federal agency has jurisdiction over a type of work site, such as mines, regulated by the Mine Safety and Health Administration (*MSHA*), or the Department of Energy’s (*DOE*) nuclear weapons facilities (regulated by DOE), OSHA would not have enforcement authority.

**SPECIAL RULES FOR  
CONSTRUCTION****Responsibility of Job  
Site Management**

In addition to complying with the Hazardous Waste Operations Standard, employers on hazardous waste sites (as well as subcontractors, construction managers, and other employers) also must comply with other relevant OSHA regulations, including the construction rules. The general provisions of the OSHA Safety and Health Regulations for Construction (29 CFR Part 1926) require that a senior member of management shall be assigned to initiate and maintain the job site Safety and Health Program and to designate “competent persons.” Individuals designated as competent persons are members of management with the authority to prevent and correct hazardous conditions.

**Competent Person Responsibilities for Job Site Safety and Health Programs**

As part of the job site safety and health program, competent persons conduct frequent and regular inspections of the job site, materials, and equipment. The job site program includes:

- Prohibition of use of any machinery, tool, material, or equipment which is not in compliance with safety standards.
- Identification, locking the controls, or removal from the job site of all machines, tools, materials, or equipment that do not comply with safety standards.
- Allowing only employees qualified by training or experience to operate equipment and machinery.
- Instructing employees in the recognition and avoidance of unsafe conditions.
- Instructing employees in the safety and health regulations applicable to their work.

To be in compliance with OSHA construction standards, every employer must designate competent persons to carry out the job site safety and health program and to supervise, inspect or perform work as specified in the standards subparts. Unless employers designate competent persons to implement the above program and, at least the Safety and Health Requirements, they will not have fulfilled their responsibility to provide a safe and healthful workplace and will be in violation of OSHA standards.

**VIDEO SEGMENT 2****EMPLOYEE WORKPLACE RIGHTS**

The OSH Act created a new agency responsible for protecting workers, OSHA. OSHA is a division of the U.S. Department of Labor. OSHA encourages employers and employees to work together to reduce workplace hazards and to implement safety and health programs.

Under the OSH Act, employees were given many new rights and responsibilities. Workers have the right to:

- Review copies of safety standards, rules, or regulations that are applicable to the employer and the workplace.
- Ask the employer for information on safety and health hazards in the workplace, precautions to be taken to prevent injury, and procedures to be followed if an employee is involved in an accident or is exposed to toxic substances.
- Review exposure and medical records that are relevant to an employee.
- Request an OSHA inspection, if the employees believe that hazardous conditions or violations of OSHA standards exist in the workplace.
- Have an authorized employee representative accompany the OSHA compliance officer during a job site inspection tour.
- Respond to questions from the OSHA compliance officer, particularly if there is not an authorized employee representative accompanying the compliance officer on the inspection walk-around.
- Observe any monitoring or measuring of hazardous materials, and be allowed to review and/or copy the resulting exposure records.
- Review the employer's Log and Summary of Occupational Injuries (OSHA No. 200) at a reasonable time and in a reasonable manner, or have an authorized representative review the information.
- Object to the length of time (the "abatement period") set by OSHA, within which an employer must correct a hazardous condition.
- Submit a written request to the National Institute for Occupational Safety and Health (NIOSH) for information on whether any substance in the workplace potentially has toxic effects in the concentration being used.

- Be notified if the employer applies for a variance from an OSHA standard, testify at a variance hearing, and appeal the final decision.
- Have names withheld from the employer, upon request to OSHA, if a written and signed complaint is filed.
- Be advised of the actions taken by OSHA in response to a complaint about a safety violation.
- File a Section 11(c) discrimination complaint if the worker is punished for exercising his or her rights under the OSHA law or regulations, or for refusing to work when faced with an “imminent danger” situation.

## **EMPLOYEE RIGHTS UNDER THE OSH ACT**

### **Access to Exposure and Medical Records**

On jobs where toxic materials or other harmful physical agents are present (such as radiation or noise), employers frequently conduct monitoring tests of the work site to determine whether a hazardous condition is present. The monitoring tests produce employee exposure records.

When OSHA standards require the employer to measure exposure to harmful substances, the employee (or a designated representative) has the right to observe the testing and to examine the records of the results. If the exposure levels are above the limit set by the OSHA standard, the employer must tell the employees who are being exposed what steps it will take to reduce the exposure levels to acceptable limits.

Workers are guaranteed the right to review and copy their medical records and exposure records, either personally or through a person whom they designate to represent them. At organized work sites, the union also has significant rights to have access to medical records and exposure information, subject to certain restrictions to insure the confidentiality of individual medical records. These records must be provided by the employer at no cost to the employee or the union. Note that these records frequently may not be in the possession of the employer, but may be held by medical professionals or clinics.

The law requires that employers provide information to their workers about the existence, location, and availability of medical records, as well as records of the employees' exposure to toxic substances and harmful physical agents. Employees must be informed of who has responsibility for maintaining the records. This information about the location and availability of medical and exposure records must be provided to employees when they first enter into employment, and at least annually thereafter.

Employers are required to keep employee medical and exposure records for a very long time. Employee medical records must be retained for the worker's length of employment plus 30 years, although an exception is made for employees who work for less than one year. For workers who are employed for less than a year, employers have the option of giving the medical records directly to the employee upon termination, and not keeping the records permanently. All exposure records developed by the employer must be kept for 30 years.

Problems with recordkeeping often arise when an employer goes out of business. If the business is acquired by another entity, the successor employer must receive and maintain the records. However, whenever an employer plans to stop doing business and there is no successor employer to maintain the records, OSHA regulations require the employer to notify current employees at least three months before closing the business of their right to gain access to their records.

## **OSHA Inspections**

OSHA encourages employers and employees to work together to eliminate hazards. Employees should make an effort to solve safety and health problems first through discussions with the employer, other workers, and union representatives. As a last resort, if a hazard cannot be corrected on the job site, an employee should contact the nearest OSHA area office. The law also allows third parties, such as the union, to file a complaint with OSHA seeking a safety inspection.

Most frequently, OSHA first becomes aware of safety complaints via the telephone or the Internet. (See “Accessing OSHA” in Appendix A at the end of this manual for more information. )

When a complaint is filed by phone or on-line, OSHA checks to determine whether the person filing the complaint is a current employee or an employee representative. The complaint process is explained, and the OSHA field representative tries to determine exactly what the hazard is and whether it appears that an OSHA standard is being violated. During this initial interview, OSHA staff will advise the person submitting the complaint of his or her right to confidentiality under the OSH Act, and ask whether he or she wants their name to remain confidential.

Although OSHA will consider and evaluate all complaints that are received, whether oral or written, complaints that are written and signed by a current employee or representative are given somewhat greater weight.

After receiving the complaint, OSHA has several different approaches to addressing the problem. In the more serious cases, OSHA will conduct an on-site “complaint inspection.”

Inspections are more likely if one or more of these factors are present:

- The complaint has been filed in writing and is signed, and there are grounds to believe that a danger exists or an OSHA standard has been violated.
- A disabling injury or illness has occurred, and the hazard still exists.
- The complaint alleges an imminent danger situation.
- The employer has a history of serious safety violations.

In other cases, the OSHA field office may decide not to schedule a job site inspection. Instead, OSHA may conduct a “complaint investigation,” which involves

notifying the employer that OSHA has been notified of a possible safety violation. This notification from OSHA may be made by phone call or sent in writing by a fax machine.

Under the complaint investigation process, the employer is required to respond in writing to OSHA with a response to the complaint, and (where appropriate) demonstrate that the hazard has been corrected. OSHA will provide a copy of the employer's written response to the person who filed the complaint. Under current OSHA policies, the complaining party then has an opportunity to dispute the employer's response, and ask that OSHA make a physical inspection of the job site. If the employer fails to respond to the initial OSHA inquiry, OSHA may decide on its own initiative to inspect the site.

The decision whether to inspect a work site generally is left to the discretion of the OSHA area office. If the Area Director decides not to conduct a site inspection, the OSHA regulations provide a limited opportunity for workers or unions to petition the OSHA Assistant Regional Administrator for review of the decision not to inspect.

An OSHA inspector may conduct a comprehensive inspection of the entire workplace, or a partial inspection limited to certain areas or aspects of the operation.

### **Employee Representatives**

Section 8(e) of the OSH Act gives workers the right to be represented during an OSHA inspection. Under the law, the workers on a site have the right to choose a representative to accompany an OSHA inspector, or "compliance officer," during the inspector's tour of the site. The representative must be chosen by the union (if there is one) or by the employees. Employers are not allowed to choose the workers' representative.

At some sites, employees may be represented by more than one union. In these situations, each union may choose a representative. Normally, the representative of each union does not accompany the inspector throughout the entire inspection, but only during the portion of the OSHA inspection involving the areas where each union's members work.

**Helping the OSHA Inspector**

Whether or not a workers' representative has been chosen to accompany the OSHA inspector, individual workers have the right to talk with the compliance officer privately, and on a confidential basis. Workers are encouraged to point out hazards, describe accidents or illnesses which resulted from those hazards, describe past worker complaints about hazards, and inform the inspector if working conditions are not normal during the inspection.

**After an Inspection**

At the end of the inspection, the OSHA inspector will meet with the employer and the employee representatives in a "closing conference" to discuss the hazards that have been found, and the actions that may be needed to abate (correct) the hazards. If it is not practical to hold a joint conference, separate conferences will be held and OSHA will provide written summaries on request.

During the closing conference, the employee representative can provide additional information about the hazards at the work site, the employees' view of the actions necessary to correct the problems, and the workers' view on how long the employer should be allowed to abate the hazard. Other facts about the history of health and safety conditions at the workplace can also be provided to the OSHA compliance officer.

**Challenging the Abatement Period**

If the OSHA inspector concludes that the employer has violated the law, OSHA may issue a citation and order the employer to fix the problem within a specific time period. Whether or not the employer accepts OSHA's actions, the employee or union has the right to contest the length of time OSHA allows for correcting a hazard.

OSHA has a formal process for objecting to the abatement period. This appeal process begins by the filing of a challenge with the OSHA area director within 15 working days after the citation is posted at the site. Because job conditions change rapidly on most construction and hazardous waste sites, employers typically are required to correct violations of OSHA standards very quickly, and the formal challenge procedure typically is not needed.

**Observing OSHA  
Directed Site  
Monitoring**

If health hazards that require monitoring tests are present in the workplace, a special OSHA health inspection may be conducted by an industrial hygienist. This OSHA inspector may take samples to measure levels of dust, noise, fumes, or other hazardous materials. The results of OSHA's monitoring tests will be provided by OSHA to the employee representative. The inspector will also gather information about the employer's efforts to control health hazards, including the results of tests the employer may have conducted.

**Reviewing OSHA  
Form No. 200**

OSHA requires employers in heavy industries (such as construction or hazardous waste remediation) who employ more than ten workers to maintain records of all work-related injuries and illnesses. This information is compiled as the employer's "Log and Summary of Occupational Injuries," also known as OSHA Form No. 200.

The employer must record all work-related injuries that result in death, lost workdays, restriction of work or movement, loss of consciousness, transfer to another job, or medical treatment (other than first aid). All diagnosed work-related illnesses also must be recorded. OSHA regulations require that employers compile this information on a calendar-year basis, and post a copy of the OSHA No. 200 report at each establishment. Employees and their representative have the right to review the employer's OSHA No. 200 data.

**Confidentiality**

OSHA will not reveal to the employer the name of the employee who requested the inspection unless the person filing the complaint indicates that he or she does not object to being identified. If a worker at a union job site is especially concerned about confidentiality, he or she can ask the union's business agent to submit the complaint on behalf of the crew.

**Employee  
Responsibilities**

Although OSHA does not issue citations against employees, or impose fines, the law specifically requires that employees "shall comply with all occupational safety and health standards and all rules, regulations, and orders issued under the Act" that are applicable to the job.

Employees should:

- Read the OSHA poster at the job site.
- Comply with all applicable OSHA standards.
- Follow all employer safety and health rules and regulations, and use the required PPE while working.
- Report hazardous conditions to the supervisor.
- Report any job-related injury or illness to the employer, and seek treatment promptly.
- Cooperate with the OSHA compliance officer conducting an inspection if the inspector asks about health and safety conditions in the workplace.
- Exercise rights under the Act responsibly.

### **Contacting NIOSH**

NIOSH can provide free information on the potential dangers of substances in the workplace. In some cases, NIOSH may visit a job site to evaluate possible health hazards. NIOSH will keep confidential the name of the person who asked for help if requested to do so.

The address for NIOSH is:

National Institute for Occupational Safety and Health  
Hazard Evaluation and Technical Assistance Branch  
4676 Columbia Parkway, R-9  
Cincinnati, Ohio 45226

NIOSH's toll-free phone number is 1-800-35-NIOSH.

### **STATE PLANS**

In addition to the federal OSHA agency, the OSH Act gives states the option of developing their own state occupational safety and health plans. If a state adopts state-level "OSHA standards" that are at least as protective as the federal OSHA standards, the federal OSHA will recognize the "state OSHA" program and defer to the state agency.

About half the states have implemented state OSHA plans that are recognized by the federal government. As a practical matter, workers in these states have all the rights guaranteed to workers under the federal OSH Act, regulations and OSHA standards. However, the agency primarily responsible for enforcement (e.g., processing complaints, conducting inspections, issuing citations) is the state OSHA agency, and not federal OSHA.

If you are working in a state with a state OSHA plan and need government assistance, you should contact the state agency for help. The following list identifies those states or territories that currently have approved comprehensive state OSHA plans (private sector as well as state and local government employees):

Alaska	North Carolina
Arizona	Oregon
California	Puerto Rico
Hawaii	South Carolina
Indiana	Tennessee
Iowa	Utah
Kentucky	Vermont
Maryland	Virginia
Michigan	Virgin Islands
Minnesota	Washington
Nevada	Wyoming
New Mexico	

In addition to the states with comprehensive state OSHA plans covering both private- and public-sector workers, two states have implemented full OSHA-recognized state health and safety plans for public-sector employees only. In Connecticut and New York, public sector employees with safety and health concerns would contact their state OSHA agency, and private sector employees continue to be covered by federal OSHA.

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**VIDEO SEGMENT 3****IMMINENT DANGER**

Most employers and their job supervisors work hard to comply with published OSHA standards and to make their job sites safe. However, in the environmental remediation industry and on construction work, where job conditions are constantly changing from day to day (and even from hour to hour), it is important that each worker be alert at all times to situations that present an *imminent* (immediate) danger of death or serious injury.

Many different kinds of job site situations might become imminent danger problems. Examples of conditions that could pose an imminent danger, depending on the circumstances, include working from high locations without appropriate fall protection equipment; unsafe trenches; broken or defective equipment such as machinery, power tools, ladders or scaffolds; exposure to unsafe levels of toxic or hazardous materials; improperly ventilated confined spaces; and many other potentially hazardous conditions.

Often, supervisors may not be aware of the problem. On the other hand, there may be a genuine disagreement between supervision and the workers on the job about whether a condition is unreasonably dangerous. What should be done?

**Notifying Management First**

The first step to take when a workplace health or safety hazard creates an imminent danger of death or serious injury is to notify the job foreman, superintendent or other responsible management representative immediately and ask: (1) that the condition be corrected and (2) that no workers be exposed to the danger until it is eliminated.

If possible, it also is very helpful to notify the union business representative or job steward about the safety problem. Because the union has an on-going relationship with management, notifying the union often is the fastest way to get effective results on the job.

**Contacting OSHA**

If the employer does not take steps to correct hazardous conditions, workers can report the problem to the nearest OSHA office. OSHA should be listed under U.S. Government, Department of Labor in the telephone directory. In the states or territories that operate their own state OSHA programs, the telephone listing of the state OSHA office typically will be found under a state government heading within the state agency responsible for labor matters, such as the state's Department of Labor and Industry.

As with any health and safety complaint, OSHA will conduct a telephone interview to get the specific facts of the situation. Workers filing complaints should be clear in identifying the hazards that concern them. If asked, OSHA will keep the name of the person filing the complaint confidential and will not tell the employer. Workers should not hesitate to give OSHA their names, addresses, and contact telephone numbers.

OSHA tries to respond very quickly to situations where workers are in imminent danger of being hurt. Immediately upon receiving the complaint from the field, the director of the OSHA area office will review the facts and decide whether OSHA should make an investigation. If the OSHA area director decides that an investigation is necessary, an OSHA inspector (or "compliance officer") will conduct an inspection of the workplace, often the same day the problem is reported.

Reports of imminent danger receive the highest priority for OSHA inspections. If OSHA cannot perform an inspection immediately, OSHA staff will contact the employer by telephone or fax to request that the hazard be corrected and that any affected employees who are exposed to the dangerous condition be removed from harm. An inspection to confirm that the danger has been eliminated will then be conducted later.

If the OSHA compliance officer finds an imminent danger, the employer will be ordered to correct the hazardous condition and remove endangered employees from the area. If the employer refuses, OSHA has the authority to seek an order from the nearest federal district court.

**Refusing Dangerous Work**

It is illegal under the OSH Act for an employer to punish workers for exercising their rights under the Act, including filing safety and health complaints with OSHA. However, sometimes a worker is confronted with a situation where he or she must make an immediate decision whether to perform work that the worker feels is unreasonably dangerous, and there simply is not enough time to contact OSHA and wait for an inspection. This is especially the case in industries like construction and environmental remediation, which are relatively dangerous under the best of circumstances and where work conditions are constantly changing. What protections does OSHA provide for workers in this situation?

This problem was recognized by OSHA soon after the OSH Act was passed in 1970, when OSHA adopted the following regulation describing the limited conditions under which the worker has a right to refuse to perform work because of a belief that the assignment is unreasonably dangerous:

**Discriminating Against Employees Exercising Rights Under the Act 29, CFR 1977.12**

Section 1977.12 Exercise of any right afforded by the Act.

(b)(1) As a general matter, there is no right afforded by the [OSH] Act, which would entitle employees to walk off the job because of potential unsafe conditions at the workplace. Hazardous conditions which may be violative of the Act will ordinarily be corrected by the employer, once brought to his attention. If corrections are not accomplished, or if there is a dispute about the existence of a hazard, the employee will normally have an opportunity to request an inspection of the workplace [by OSHA] . . . Under such circumstances, therefore, an employer would not ordinarily be in violation of section 11(c) by taking action to discipline an employee for refusing to perform normal job activities because of alleged safety or health hazards.

(b)(2) However, occasions might arise when an employee is confronted with a choice between not performing assigned tasks or subjecting himself to serious injury or death arising from a hazardous condition at the workplace. If the employee, with no reasonable alternative, refuses in good faith to expose himself to the dangerous condition, he would be protected against subsequent discrimination. The condition causing the employee's apprehension of death or injury must be of such a nature that a reasonable person, under the circumstances then confronting the employee, would conclude that there is a real

danger of death or serious injury and that there is insufficient time, due to the urgency of the situation, to eliminate the danger through regular statutory enforcement channels [such as an OSHA compliance inspection]. In addition, in such circumstances, the employee, where possible, must also have sought from his employer, and been unable to obtain, a correction of the dangerous condition.

Although the text of this regulation is somewhat complicated, it does state several basic principles that outline the circumstances under which a worker's refusal to perform unreasonably dangerous work is considered a right under the OSH Act.

- (1) An initial principle (subsection b[1], above) is that normally, a worker who is concerned about a safety and health problem is expected to continue performing the assigned work, and try to remedy the problem through the regular channels—up to and including the filing of an OSHA complaint.
- (2) In order for the worker to be able to refuse work and still enjoy legal protections under OSHA (subsection b(2)), the employee must have a good faith belief that there is a risk of serious injury or death if he or she performs the work.
- (3) The employee's fear or apprehension must be of such a nature that a reasonable person would agree that the fear is legitimate.
- (4) In addition to believing in good faith that there is an imminent danger, the circumstances must be such that there is insufficient time to eliminate the danger through an OSHA inspection.
- (5) To be eligible for OSHA protection when refusing dangerous work, an employee, where possible, also must ask the employer to correct the problem, without favorable results.

As a practical matter, the most useful approach a worker can take when assigned to a task that the worker believes may result in serious injury or death is to ask for an alternative work assignment. By asking for different work, an employee establishes that he or she is

willing to perform work—just not work that they believe is unreasonably dangerous. Requesting an alternative work assignment normally establishes the worker’s good faith, and clearly demonstrates that the employee has attempted to convince the employer to correct the problem.

Figure 11-1 on the following pages illustrates a court decision on how the “right to refuse hazardous work” operates in the workplace.

**ELIZABETH DOLE, SECRETARY OF LABOR V. H.M.S. DIRECT MAIL SERVICE, INC.  
752 F. Supp. 573 (1990)**

**THE FACTS**

The Employer, H.M.S. Direct Mail Service, is a direct mail and printing business. One of the pieces of equipment used in the shop is a commercial binding machine. The binding machine contains stitching mechanisms and paper cutters (knives). Sometimes the paper being fed into the machine jams, and must be removed manually. When this happens, the machine is stopped by a braking mechanism that is triggered by the operator.

James Malek was an H.M.S. employee who worked the binding machine. On Thursday, May 9, 1985, he was assigned to operate the machine, but he believed that the machine was unsafe because the brake was malfunctioning. He advised his supervisor, Blanch Cena, that he would not operate the machine.

The supervisor did not offer Malek an alternative work assignment, but instead ordered him back to the binding machine. Malek refused the work. He left a note on the machine to warn other employees that the safety brake was broken, and went home. The next morning, the company suspended Malek for three days for insubordination.

When Malek returned to work on May 15, after his suspension, the supervisor again assigned him to operate the binding machine. After operating the machine for a short while, Malek determined that the brake still was malfunctioning. Because he believed the machine to be unsafe, he again refused to operate it. The company accommodated his concerns temporarily, assigning him to operate a web press, but later the same day Malek was ordered back to the binding machine.

Malek insisted that the binding machine was unsafe, and asked for alternate work, and finally refused to operate the binding machine. He was discharged.

**THE DECISION**

OSHA Section 11(c) makes it unlawful to discriminate against an employee for exercising “any right” protected under the OSH Act. One such right is found at 29 CFR 1977.12. This regulation protects a worker’s right to refuse to work under conditions the worker believes will pose an imminent threat of serious injury or death. By virtue of the regulation, where a worker is confronted with a choice of refusing an assigned task or performing the task at the risk of serious injury or death, Section 11(c) protects the worker from subsequent discharge if the worker, having no reasonable alternative, refuses to perform the assigned task. The worker’s apprehension of serious injury is measured by the standard of a reasonable person under the circumstances.

**Figure 11-1.** Facts and Decision of Elizabeth Dole, Secretary of Labor v. H.M.S. Direct Mail Service, Inc.

**To prevail in this case, the Labor Department must establish the following four elements:**

1. When told to operate the binding machine on May 9 and May 15, Malek believed there was a risk of serious injury or death, and insufficient time to eliminate the danger through regular enforcement channels (i.e., calling for an OSHA inspection);
2. A reasonable person under Malek's circumstances would have believed there was a risk of serious injury or death from operating the machine.
3. If possible, Malek sought and was unable to obtain a correction of the dangerous situation from his employer.
4. Refusal to operate the binding machine was a substantial reason for Malek's discharge.

**The evidence presented in the case established all four elements.**

1. There had been prior accidents in which other workers had been injured while running the binding machine. The brake on the machine had been experiencing problems prior to the incidents involving Malek. Malek had observed the machine malfunctioning on the days involved. Although Malek contacted OSHA after refusing to operate the machine both on May 9 and May 15, it obviously was impossible for OSHA to inspect the machine quickly enough to avoid the dilemma Malek confronted.
2. The Court also was satisfied that Malek's apprehension was reasonable under the circumstances.
3. The Court found that Malek sought out his employer to correct the problem, and that he asked for an alternative work assignment.
4. Finally, while the Court received evidence suggesting that Malek was a problem employee whose own conduct independently had given cause for a suspension or termination at other times, the immediate cause for his suspension and termination was in response to his exercise of his right to refuse hazardous work under Section 1977.12. This type of retaliation violates an employee's Sec. 11(c) rights.

(The Secretary of Labor's order directing the company to reverse its discriminatory actions against Malek was upheld by the court.)

**Figure 11-1** (cont.). Facts and Decision of Elizabeth Dole, Secretary of Labor v. H.M.S. Direct Mail Service, Inc.

**How the “Right to Refuse Hazardous Work” Applies to Health Hazards**

OSHA regulation 29 CFR 1977.22 states that a worker can refuse to perform work when the work presents a risk of death or serious injury. However, the condition causing the employee’s apprehension of death or injury must be of such a nature that reasonable person also would conclude that there is a real danger of death or serious injury, and the danger is so immediate and urgent that the hazard cannot be addressed adequately by asking for an OSHA investigation.

The “urgency” of many safety hazards (trips/falls, punctures/lacerations, electrocutions) usually is obvious, because workers can see the likelihood of direct injury. Some health hazards (exposure to toxic materials or harmful physical agents) can be equally clear, such as when a worker encounters life-threatening (IDLH) concentrations of toxic gases, vapors, liquids, or radioactive material. These types of exposures to toxic substances or dangerous fumes, dusts, or gases can cause irreversible physical harm, shortened life, or reduced physical or mental performance.

Much of the time, however, it is not so clear that a health hazard is so urgent that an employee is justified in refusing to perform work. Many health hazards cause illness only after an extended period of time, yet there are scientific studies that indicate that damage to the body (such as the cancer process) can begin with a single exposure. In such cases the right to refuse hazardous work should be equally available when a health hazard is encountered, subject to the general limitations of the OSHA rule that requires employees to take appropriate steps to correct the problem through normal channels.

**VIDEO SEGMENT 4****OSHA SECTION 11(c) RIGHTS**

Under the OSH Act, workers were given new and important rights that protect their safety on the job, including the right to speak out about safety problems, file formal complaints with OSHA if they believe that job conditions violate safety standards, and participate in OSHA inspections.

When adopting the OSH Act in 1970, Congress recognized that these provisions would be meaningless if workers feared that they would be fired or otherwise penalized for exercising their rights. To ensure that workers would be able to make use of their rights, Congress included strong language in the statute outlawing discrimination by employers or other persons against workers who engage in activities protected by the OSH Act.

(Note: In the context of safety and health activities, discrimination means being treated differently, and unfavorably, because a worker participates in activities protected under the OSH Act and its regulations. Basically, discrimination as used under the OSH Act is the same as retaliation.)

The provisions of the OSH Act that ban discrimination against workers who exercise their rights are found in Section 11(c) of the Act, and often are referred to as the “11(c) Rights”:

- (11)(c)(1) No person shall discharge or in any manner discriminate against any employee because such employee has filed any complaint or instituted . . . any proceeding under or related to this Act or has testified or is about to testify in any such proceeding or because of the exercise by such employee on behalf of himself or others of any right afforded by this Act.
- (2) Any employee who believes that he has been discharged or otherwise discriminated against by any person in violation of this subsection may, within thirty days after such violation occurs, file a complaint with the Secretary [of Labor] alleging such discrimination. Upon receipt of such complaint, the Secretary shall cause such investigation to be made as he or she deems appropriate. If upon such investigation, the Secretary determines that the provisions of this subsection have been violated, he or she and shall bring an action in any appropriate United States district court against such person. In any such action the United States district courts shall have jurisdiction, for cause shown to restrain violations of paragraph (1) of this subsection and order all appropriate relief including rehiring of or reinstatement of the employee to his former position with back pay.
- (3) Within 90 days of the receipt of a complaint filed under the subsection the Secretary shall notify the complainant of his or her determination under paragraph (2) of this subsection.

It is against the law for an employer or any other person to punish a worker for exercising OSHA rights. Section 11(c) of the OSHA law was written to protect workers from retaliation if they engage in protected activities such as the right to:

- Complain to their employer about job safety or health conditions.
- Discuss health or safety matters with other workers.
- Participate in union activities concerning health and safety matters.
- Participate in workplace health and safety committee activities.
- File health or safety grievances.
- Refuse to perform work that they believe poses an unreasonable risk of serious injury (but only under certain conditions).
- File a complaint about workplace health or safety hazards with OSHA, state agencies, local health department or fire department, or any other government agency.
- Participate in OSHA inspections.
- Testify before any panel, agency or court about job hazards.
- File 11(c) complaints.
- Give evidence in connection with 11(c) complaints filed by other workers.

Most employers respect the law and are very willing to work with their employees to ensure the job site is safe. However, there are a variety of retaliatory actions that unfair employers may take to punish workers who exercise their rights under the OSH Act.

Under Section 11(c), it is illegal for an employer to take these kinds of action against a worker as a punishment for exercising OSHA rights:

- Firing
- Demoting
- Assigning a worker to an undesirable job or shift
- Loss of seniority
- Denying a promotion
- Denying benefits that the worker has earned, such as sick leave or vacation time
- Spying on the worker
- Harassing the worker
- Blacklisting with other employers
- Trying to cut off a worker's credit at banks or credit unions

OSHA protects workers from these and other punishments if they are in response to exercising OSHA rights. If an employer is engaging in these types of actions in retaliation for exercising rights guaranteed under other laws or the union contract, workers would have the right to protest discrimination by contacting the union or another appropriate government agency.

Note that OSHA generally cannot protect a worker under Section 11(c) who is disciplined by the employer solely for refusing to comply with OSHA regulations, or not complying with other valid health and safety rules established by your employer.

**Important note:** Employees who are unsure as to whether or not their OSHA rights have been violated should contact OSHA immediately and ask.

### **11(c): Steps to Take if OSHA Rights are Violated**

If a worker believes that he or she has been punished for exercising an OSHA right, it is very useful to write down the basic facts promptly, while all the facts are still fresh. Information that should be recorded includes:

- Names of people involved with addresses, if available
- An accurate description of what happened
- Names of witnesses who can confirm when, where, and what happened
- Any other significant information

In addition to writing notes, it also is important to keep copies of all relevant documents, letters, slips, etc.

The time limitation for notifying OSHA about the problem is extremely important. Within 30 days of the time a worker becomes aware of the discriminatory action, information about the action should be reported to OSHA in person, by letter, or by telephone. Generally, OSHA staff will assist in processing the complaint by completing the paper work.

On union job sites, many workers may choose to file a grievance first against an employer under the collective bargaining agreement, working through their union hall. Grievances often can be relatively fast and effective in resolving this kind of dispute. However, even if the union is pursuing the grievance actively, it is important that workers also notify OSHA of the discrimination problems within the 30-day time limit specified by law, so that they will still have the right to pursue their remedies under Section 11(c) if their grievance is unsuccessful.

- Failure to do so within 30 days may jeopardize your complaint.
- File complaints in the nearest OSHA area office.
- Workers may file a complaint themselves, or authorize a representative to do so for them.

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**PART B****ENVIRONMENTAL  
LAWS**

Throughout most of our nation's history, there have been no laws to protect the environment. We seemed to operate under the belief that the world's resources were unlimited. Garbage that was dumped on privately-owned land was treated as a private matter—even though the material might someday pollute the wells of the neighbors down the road. No one was concerned about the smoke coming out of the factories. After all, the factories were a sign of progress, and the dirty air, well, it would blow somewhere else. We poured industrial and municipal sewage into our rivers, believing that it was someone else's problem.

Since the 1950s there has been a tremendous change in our national approach to environmental issues. Gradually we have learned the extent of the damage we were causing to the land, plant life, animals, and ourselves. Increasingly, we have come to realize that the welfare of human life is linked to the health of everything in the environment.

Pesticides applied to crops gradually flow into the streams, where they may injure insects and fish. If not controlled, the emissions from coal-burning power plants can kill entire forests hundreds of miles away. Drums of hazardous wastes that were dumped years ago continue to seep into the groundwater and streams. The dusts and chips from lead-based paint can cause permanent brain damage, while asbestos-containing materials in buildings may cause fatal diseases many years after a person is exposed to them.

The goal of environmental laws is to reduce the level of new pollution that is released into the environment from sources such as factories, manufacturing plants, and automobiles, as well as to clean up existing sites that have been contaminated. Consider for a moment what you would do if confronted with one of the following hypothetical problems. What laws would govern your actions?

**Problem 1**

Kathy is a Laborer working for Ace Environmental Company. Ace is cleaning up a Superfund site. The clean-up involves pumping toxic chemicals from storage ponds into barrels that are labeled, and then shipped to a waste treatment plant across town. The treatment plant has an EPA disposal permit.

Normally, Ace uses Smith Waste Transport, Inc. to haul the barrels from the hazardous waste site. This week, however, several of Smith's trucks are broken down, and Smith's clean-up work is being delayed. Ace's job foreman directs Kathy to load the barrels into an Ace truck and then drive the truck with the barrels to the treatment plant. When Kathy asks the foreman for the paperwork to accompany the waste shipment, she is told not to worry about it.

**Problem 2**

John works in the warehouse of Medico Corp., a medical products manufacturer. Medico's manufacturing process generates about five barrels of liquid hazardous waste per week, each weighing about 250 lbs. The metal barrels are labeled and stored in the warehouse. Every six months the drums are shipped to an approved disposal contractor.

John's supervisor notices that three of the metal drums are leaking. The supervisor tells John to wipe up the leaking waste and empty the liquid into some new plastic drums. John is told to move the plastic drums to the company warehouse, about a mile down the highway, and to get rid of the dirty rags in the dumpster behind the office.

**Problem 3**

Mark is an equipment operator at the Strawberry Fields hazardous waste site. On one section of the site is a cluster of buried drums. Although the drums are not labeled and have not been tested, samples of the soil near the drums show heavy concentrations of arsenic and lead.

Eventually the contaminated soil will be treated on the waste site, but the treatment equipment has not been set up yet. The job superintendent is anxious to get to the buried drums and tells Mark to excavate the area. A

second equipment operator, Jim, will haul the soil to a temporary storage pile on a marshy portion of the edge of the site about a mile away, about 300 yards from some farmhouses.

#### **Problem 4**

Curtis lives near the Videotex Co. factory where magnetic tape is made. He has heard rumors about the chemicals used in the manufacturing process. He has always worried about what materials may be stored there, and would like more information.

#### **Problem 5**

Steve is a truck driver for Tatum Trucking, which is registered with the EPA as a hazardous waste transporter. Tatum has a contract with a local dry cleaning plant to dispose of the plant's waste solvents. The actual disposal work is subcontracted to Kane Chemical Treatment, which operates under an EPA hazardous waste disposal permit.

Steve has picked up this week's waste solvent, and needs to return empty barrels to the dry cleaning plant in a couple of days. But Joe Tatum is having financial problems, and is not paying his bills. Kane Chemical Treatment has refused to accept this shipment of waste solvent for disposal. Joe Tatum asks Steve to "see what he can do" to get rid of the solvent, and reminds him of the creek behind the warehouse.

Comments on the problems given above will be given later in this section.

### **OVERVIEW OF THE ENVIRONMENTAL LAWS**

As a hazardous waste worker, your work will bring you into contact with many environmental laws. However, the laws you will be dealing with the most are the Resource Conservation and Recovery Act (*RCRA*) and the Superfund law, the Comprehensive Environmental Response, Compensation and Liability Act (*CERCLA*). It is essential that you know the basic issues that these laws cover, and the role they may play in determining how you perform your work.

Most of the environmental laws are enforced by the U.S. Environmental Protection Agency (*EPA*). The EPA was established in 1970, and it has grown rapidly as Congress has adopted new laws to regulate hazardous materials and clean up the environment. Several of the major laws administered by the EPA are described briefly below.

Three major laws regulate the release of new pollutants into the environment from many different sources, including industrial facilities, cars, sewage treatment, and farm runoff. These laws are:

1. Clean Air Act
2. Clean Water Act
3. Safe Drinking Water Act

In addition, several other related laws regulate toxic and hazardous materials at different phases of their existence:

- Toxic Substances Control Act – Requires manufacturers to test their products to determine whether they may be hazardous, and then list any hazardous materials with the EPA.
- Resource Conservation and Recovery Act – Regulates hazardous waste materials from the time they are created until their disposal.
- Comprehensive Environmental Response, Compensation, and Liability Act – The Superfund law, addresses the cleanup of hazardous materials that were released into the environment sometime in the past, and that pose a current or potential hazard.
- Hazardous Materials Transportation Act – Regulates shipping of hazardous materials.
- Emergency Planning and Community Right-to-Know Act – Requires state and local governments to develop emergency response plans for dealing with releases of hazardous materials, and requires facilities to provide the government with an inventory of the hazardous substances stored or used at their sites.

**Clean Air Act**

The Clean Air Act (42 U.S.C. § 7401) controls emissions of pollutants into the air. The law requires facilities that produce air pollution to obtain permits before they release harmful substances into the air.

The goal of the Clean Air Act is to control air pollution at its source. When a new facility is built, or an old facility is modified, it must meet “new source performance standards” established by the EPA. Some types of air pollution sources subject to EPA standards are obvious, such as “smokestack” facilities such as factories, power plants, and incinerators. If you are working at a cleanup site that involves incineration of hazardous waste, a permit may be required for the incinerator.

Less obvious facilities that also are regulated are operations where nothing is burned, but which emit toxic dusts, gases, or vapors. Examples of such facilities that must meet federal air pollution standards when they are built new or are modified include sewage treatment plants, chemical storage tanks, petroleum and natural gas plants, industrial painting and coating plants, dry cleaning plants, asphalt processing plants, grain elevators, and rubber plants.

State governments are heavily involved in controlling air pollution under the Act. Each state is required to develop a plan that will bring overall air quality into compliance with standards established by the EPA. Whether a particular pollution source will need a permit will depend upon the specific requirements of the state implementation plan. The state regulatory controls are strictest in locations where existing air quality already is very poor, and drastic measures are needed to upgrade existing conditions. In less-developed areas that meet basic air quality standards, the primary goal is simply to prevent any serious deterioration in existing air quality.

**National Emission Standards for Hazardous Air Pollutant**

In addition to setting air pollution performance standards for various classes of facilities, under the Clean Air Act the EPA has adopted the National Emission Standards for Hazardous Air Pollutants (*NESHAP*) which regulate the release of specific hazardous substances. For example, the EPA’s NESHAP standards include rules governing the techniques used

when demolishing buildings that contain asbestos-containing materials, including the predemolition removal of certain asbestos-containing materials, prohibitions on “dropping” asbestos-containing materials during demolition, and wetting requirements (40 CFR §61.140).

Another NESHAP standard (40 CFR §61.90) applies specifically to the control of radioactive materials at DOE facilities. Operators of DOE facilities that produce radioactive emissions are required to provide the EPA with a written description of the amount and type of such emissions, the maximum level of exposure to radioactivity that a nearby resident would be exposed to, and the equipment that has been installed to control the radioactive pollution source. This NESHAP standard also requires that records used to calculate the level of exposure that might be encountered by the public must be kept at the DOE facility for five years (40 CFR §61.95).

## Employee Protection

The Clean Air Act and most of the environmental laws provide protection against discrimination for employees who report violations of the law. The Clean Air Act (42 U.S.C. §7622.) provides:

### *Employee Protection*

- (a) No employer may discharge any employee or otherwise discriminate against any employee with respect to his compensation, terms, conditions or privileges of employment because the employee . . .
  - (1) commenced . . . or is about to commence . . . a proceeding under [the Clean Air Act] for the administration or enforcement of any requirement imposed under [the Act],
  - (2) testified . . . in any such proceeding, or
  - (3) assisted or participated . . . in such proceeding.

An employee who believes that his or her rights have been violated can file a complaint of discrimination with OSHA within 30 days of the alleged violation.

If an employee's rights have been violated and a successful discrimination complaint is filed, the Labor Department can order reinstatement, back pay, and recovery of attorney fees and other losses incurred by the employee.

The Clean Air Act authorizes individual citizens to file suit against violators of the Act, including persons who seek to construct a major emitting facility without first obtaining a permit. In addition, the EPA Administrator is given the authority to take action to stop violations of the law that present an imminent and substantial danger to human health.

The Clean Air Act and most other environmental laws apply to federal facilities.

## **Clean Water Act**

The Federal Water Pollution Control Act (commonly known as the Clean Water Act, 33 U.S.C. §1251) is an ambitious effort to clean up the nation's waterways. Like the Clean Air Act, the Clean Water Act seeks to control or eliminate water pollution at its source by requiring permits for the discharge of materials or waste into waterways. The law also applies to federal facilities.

The Clean Water Act deals principally with cleaning up surface water in streams and lakes. Problems with underground pollution primarily are addressed by the Safe Drinking Water Act.

The Clean Water Act provides that "the discharge [into a waterway] of any pollutant by any person is unlawful" unless the discharge meets EPA and state regulations. Any and all discharges, from both existing facilities and new ones, must have individual permits identifying the specific pollutant, as well as the amount and concentration to be released. Under the Act, any hazardous emissions into waterways must be reduced by the use of the best available technology economically achievable.

The Act establishes as national policy that there should be no discharges of oil or hazardous substances into navigable or territorial waters from ships, and assesses civil penalties for spills. Other sections of the Clean

Water Act give the Army Corps of Engineers the authority to issue permits to control the discharge of dredge or fill materials into waterways.

The EPA has broad authority under the Act to require any person in control of a pollution source to keep detailed records and engage in sampling. The law specifically mandates that these records are to be available to the public. Like the Clean Air Act, the Clean Water Act authorizes citizen suits against those who violate the law.

### **Safe Drinking Water Act**

The Safe Drinking Water Act (42 U.S.C §300f) was enacted to insure that the public's supply of drinking water would be safe. Under the Act, the EPA establishes quality standards for drinking water, setting limits on the level of contaminants allowed. Although most of the responsibilities for protecting water supplies are assigned to the states, the EPA has authority to intervene, if needed.

In addition to establishing water quality standards, the Act generally prohibits the underground injection of hazardous materials, with limited exceptions. State governments also are required to create programs for protecting wellheads from contamination.

The Safe Drinking Water Act includes provisions for citizens suits, and also discrimination protections for employees who file complaints or participate in hearings or investigations, if their complaint is filed within 30 days of the employer's alleged discriminatory act.

### **Resource Conservation and Recovery Act**

The Resource Conservation and Recovery Act (RCRA, 42 U.S.C. §6901), is the "core statute" in our nation's effort to regulate the hazardous waste materials that constantly are created by business, institutions, and government. RCRA seeks to create a "cradle to grave" system for tracking hazardous waste, from the time it comes into existence until its disposal. The EPA's RCRA regulations also apply to federal agencies.

RCRA applies to hazardous waste that, because of its quantity, concentration, or physical, chemical or infectious characteristics, may cause an increase in mortality or serious illness, or which poses a substantial present or potential threat to human health or the environment if not managed properly. This includes materials that are ignitable, corrosive, reactive, extraction procedure toxic, acute hazardous wastes, and toxic wastes.

Under RCRA, the EPA has listed large numbers of individual waste materials, each with a specific EPA hazard code. Normal household wastes are excluded from coverage under RCRA.

Special rules apply to each of the three broad categories of companies or persons that are involved with hazardous waste materials

- Facilities that generate waste
- Transporters of hazardous materials
- Treatment, storage, and disposal (*TSD*) facilities.

#### Facilities that Generate Wastes

The RCRA rules for facilities that generate (create) hazardous wastes (40 CFR Part 262) generally apply to all sites that produce at least 100 kilograms (220 pounds) of waste per month. Each such facility must:

- Obtain an EPA identification number;
- Maintain required records to identify the quantities, make-up, and disposition of wastes;
- Accumulate wastes in proper containers;
- Use correct container labeling procedures;
- Use a manifest system for tracking waste;
- Deliver hazardous wastes only to authorized transporters or facilities; and
- Submit required reports to the EPA or state agencies.

### Transporters of Hazardous Wastes

Companies that transport hazardous wastes are regulated under the Hazardous Materials Transportation Act (below), which is administered by the Department of Transportation. A transporter under RCRA is anyone who engages in off-site transportation of hazardous waste by air, rail, highway, or water.

Waste transporters, under 40 CFR Part 263, are required to:

- Obtain an EPA identification number;
- Comply with the manifest system, including keeping the manifest with the hazardous materials at all times;
- Immediately report any accidental discharge to the National Response Center;
- Clean up any discharge.

### Treatment, Storage and Disposal Facilities

RCRA includes comprehensive regulations governing facilities that ultimately Treat, Store or Dispose of hazardous wastes. These operations are commonly known as “*TSD facilities*.” Note that a firm that generates hazardous waste as part of its manufacturing process becomes subject to RCRA’s regulations as a “storage” facility if it keeps more than one 55-gallon drum of hazardous wastes on-site for more than 90 days.

Under the RCRA rules TSD facilities must:

- Apply to the EPA for an operating permit, including a training plan for all workers at the TSD site;
- Secure the site from entry by unauthorized persons or livestock;
- Regularly inspect equipment for safety, and maintain at the facility a written schedule for inspecting monitoring, safety, and emergency equipment;
- Develop an emergency plan for the site;
- Keep a manifest system, retaining records for at least three years.

Workers at RCRA sites are entitled to training that will allow them to perform their work safely in accordance with the facility's RCRA requirements. The training must be provided by a person trained in hazardous waste management procedures. The training at TSD facilities must include emergency response procedures, equipment, and systems.

The EPA's regulations for TSD facilities include specific detailed requirements for the use of containers, tank systems, surface impoundments (ponds), waste piles, land treatment, landfills, and incinerators.

TSD facilities must prepare a contingency plan for handling emergencies. In addition to training workers in emergency preparedness, a copy of the contingency plan must be provided to all local police and fire departments, hospitals, and state and local emergency response teams that may be called upon to provide emergency services.

### **Manifest System**

The manifest system is a central part of the RCRA system. By creating a paper trail, the manifest system makes it possible to track hazardous materials at each step, until the materials are disposed of properly.

The most common form used for implementing the manifest system is called the Uniform Hazardous Waste Manifest (*UHWM*), which was developed by the EPA. The UHWM is a multiple-copy form, and each person or company that has a role in handling hazardous material is responsible for adding additional information to the form and keeping one of the copies.

The initial information on the manifest form is completed by the generator. The generator's name, address, and EPA identification number must be stated, a complete list of the types and quantities of hazardous material being shipped must be provided, as well as other identifying information. The waste generator must sign and date the manifest, and the first transporter also must acknowledge receiving the shipment by signing the manifest. The generator keeps the first copy of the form.

The EPA identification number for each transporter also must be included on the manifest. As the material is passed-along from transporter to transporter, or from transporter to disposal site, additional portions of the manifest are completed indicating who received the shipment and its condition. Each party keeps one of the copies of the form.

When the shipment is received by the TSD facility, the TSD operator signs and dates the manifest, and keeps a copy for its records. A copy of the completed manifest—with a full set of signatures showing the generator, transporter(s) and TSD operator—is then sent back to the generator. This document shows that the hazardous waste product has been disposed of safely. If the manifest is incomplete, the generator must investigate to determine what happened to the waste materials.

RCRA includes a broad protection for workers against retaliation for reporting problems, and also allows citizen lawsuits against facilities in violation of the law. The EPA maintains an RCRA-Superfund Hotline (1-800-424-9346) for answering technical questions about the law.

### **Superfund Law CERCLA**

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. § 9601, better known as the Superfund law, was enacted in 1980 to create a system for cleaning up the thousands of sites throughout the United States contaminated with abandoned hazardous waste materials.

Enactment of the Superfund law was spurred along by the experiences of citizens who lived in an area near Buffalo, New York known as Love Canal. Love Canal had been abandoned and drained of water decades ago, and for many years local chemical companies had used the dry canal bed as a dumping site for an assortment of toxic materials. Eventually, earth fill was hauled onto the site, and the canal and the toxic waste were completely covered. Homes were built, but the homeowners generally were unaware of the toxic materials beneath them.

By the late 1970s, it became clear to the Love Canal residents that something was very wrong. An unusually large number of residents were developing serious illness, particularly children. After investigation, the residents and medical experts became convinced that the cause of the illnesses was the “chemical soup” underneath their homes.

It took years to sort out the problems at Love Canal and begin to find a solution—years in which the residents continued to be exposed to toxic materials. The Love Canal experience pointed to a fundamental problem with the cleanup of older hazardous waste dumps—namely, identifying the party responsible for dumping the materials in the first place. In many cases the responsible parties cannot be identified at all, or they may no longer be in business. However, in light of the seriousness of the problem, the public demanded that Congress find a way to clean up the problems nationwide. The answer was the Superfund.

Under Superfund, the EPA periodically publishes its *national priority list* of the most harmful clean up sites. The EPA attempts to determine who is responsible for creating the hazard at each site. If those entities can be identified, the government may file suit to force them to clean the site. If the responsible parties cannot be found, the EPA will clean up the site using money from the Superfund. The Superfund monies come from taxes levied on chemicals. Like RCRA, Superfund authorizes citizen suits.

In 1986 the Superfund law was amended by Congress when it enacted the Superfund Amendments and Reauthorization Act, or SARA. One of Congress’ concerns when it passed SARA was that no rules or procedures had been established to protect the workers involved in clean up activities. Too often, workers were being sent to perform the work without any protection at all. Congress realized that this was inconsistent. After all, if the materials were so dangerous that they should be removed from the community, was it not hazardous for workers to come into direct contact with them? In

## Hazardous Materials Transportation Act

response to this concern, as part of SARA, Congress ordered the Labor Department to develop the OSHA standard for hazardous waste workers.

Control of hazardous materials that are shipped by air, rail, truck, or ship are the responsibility of the Secretary of Transportation under the Hazardous Materials Transportation Act, 49 U.S.C. §1801. The EPA works cooperatively with the Department of Transportation in implementing the law.

The Act applies to **HAZMAT employers** and **HAZMAT employees**. For the purposes of the transportation regulations, these terms are defined very broadly. For example, HAZMAT employers are anyone who:

- Transports hazardous materials in commerce, or causes such materials to be transported; or
- Reconditions or tests containers, drums or packages used for transporting hazardous materials.
- The law specifically applies to owner-operators.

Hazmat employees under the transportation regulations include anyone who:

- Operates a vehicle used to transport hazardous materials;
- Loads, unloads or handles hazardous materials;
- Reconditions or tests containers, drums or packages;
- Prepares hazardous materials for transportation; or
- Is responsible for the safety of the transportation of hazardous materials.

Hazmat employees must be provided with training prior to beginning their duties. The training covers such areas as the hazardous materials classification system; Department of Transportation (DOT) labeling, placarding, and marking systems; general handling techniques; health, safety, and risk factors associated with transportation of hazardous materials; emergency

response steps; use of the DOT Emergency Response Guidebook; HAZMAT transportation regulations; personal protection techniques; and preparation of shipping documents.

The Act (49 U.S.C. §1809) makes it a criminal offense knowingly to remove or alter package labels or placards, the materials manifest, or to tamper with any hazardous material packages or the vehicles used for transporting them.

### **Toxic Substances Control Act**

Under the Toxic Substances Control Act (*TSCA*)(15 U.S.C. §2601), EPA requires manufacturers and processors to test substances to determine whether they present an unreasonable risk of injury to health or the environment. Persons who manufacture or process new substances, or who plan to apply substances to significant new uses, must notify the EPA of their plans and submit test data. The EPA is authorized to regulate these substances, including, if appropriate, a ban on their manufacture or use.

Any person who manufactures, processes or distributes chemical substances in commerce is required to keep records of any adverse effects to health or the environment. TSCA requires that records of any adverse effects to employees be retained for 30 years. Records of other harmful effects, including claims of harm filed by consumers, must be kept for five years. The law does not require that manufacturers make these reports directly available to the public, but they must be supplied to the EPA.

Like most of the environmental statutes, TSCA authorizes citizen suits against anyone who violates the law, or against the EPA to compel enforcement of the law. TSCA also includes procedures under which individuals can petition the EPA to issue regulations to control specific substances, if the person believes that the EPA's existing approach is not adequate. Employees are protected against retaliation for reporting violations of the law or participating in investigations or hearings.

**Emergency Planning  
and Community  
Right-To-Know Act**

Just as citizens throughout the United States grew more and more concerned about hazardous wastes in connection with the Love Canal problems, many community residents living near factories and chemical storage facilities expressed concern about the possibility that chemicals being used at these facilities might also pose similar health risks. During the 1970s, there were increasing demands that businesses and other entities, including government agencies, disclose what materials were used or stored at their facilities. Unions also began lobbying for greater disclosure of information to workers about the hazards of the materials they were handling.

In essence, both communities and workers were demanding the right to know what hazards they might be exposed to. If people are armed with the facts, then they have a better chance to protect their health and safety.

Several states passed right-to-know laws at the state level, and in 1983 OSHA issued its Hazard Communication Standard, 29 CFR § 1910.1200. The HazCom Standard is discussed in detail in another section of this course.

In 1984, an accident occurred at a chemical plant near Bhopal, India, owned by the Union Carbide company. During the night, toxic gas leaked from the facility, killing several thousand residents while they were sleeping.

The disaster at Bhopal spurred action from the U.S. Congress, which enacted the Emergency Planning and Community Right-to-Know Act, 42 U.S.C. §11001. Under the Act, manufacturers and processors are required to report information to the government about their facilities. The Act requires employers to submit:

- Inventories of hazardous materials that are present at the facility
- Material safety data sheets
- Reports of any chemical releases from the facility
- Emergency response plan
- Follow-up emergency notices

These inventories are extremely important in planning emergency responses, and also in providing emergency responders such as HAZMAT teams or fire fighters with the information they need to perform their jobs effectively and protect their health at the same time. Except for situations involving trade secrets, all of the reports provided to the government are to be made available to the general public.

The Act requires the creation of local emergency planning committees to consider what preparations should be made for handling events involving hazardous materials. The Act also provides inspection rights to fire departments having jurisdiction over the facility, including the right to have specific information about the location of hazardous chemicals at the site.

## REVIEW

Now that we have reviewed the requirements of some of the environmental statutes, we will look again briefly at the hypothetical problems that we posed earlier:

### Problem 1

Kathy is a laborer working for Ace Environmental Company. Ace is cleaning up a Superfund site. The clean-up involves pumping toxic chemicals from storage ponds into barrels that are labeled, and then shipped to a waste treatment plant across town. The treatment plant has an EPA disposal permit.

Normally, Ace uses Smith Waste Transport, Inc. to haul the barrels from the hazardous waste site. This week, however, several of Smith's trucks are broken down, and Smith's work is being delayed. Ace's job foreman directs Kathy to load the barrels into an Ace truck and then drive the truck with the barrels to the treatment plant. When Kathy asks the foreman for the paperwork to accompany the waste shipment, she is told not to worry about it.

**Comment:** Under the Hazardous Materials Transportation Act, Kathy must be trained in techniques for safe transportation of material prior to being assigned to such work. Without proper transportation training, the employer would be violating the law to direct Kathy to transport the materials.

In addition, hazardous materials are subject to the manifest system, and should not be removed from the site without a manifest. The disposal site should not receive the materials without the manifest documents. Kathy should refuse to violate the law. Under CERCLA, she would be protected against retaliatory action from her employer. If Ace were a contractor at a DOE site, Kathy also would be protected from retaliation under DOE's Contractor Employee Protection Program.

## **Problem 2**

John works in the warehouse of Medico Corp., a medical products manufacturer. Medico's manufacturing process generates about five barrels of liquid hazardous waste per week, each weighing about 250 lbs. The metal barrels are labeled and stored in the warehouse. Every six months the drums are shipped to an approved disposal contractor.

John's supervisor notices that three of the metal drums are leaking. The supervisor tells John to wipe up the leaking waste and empty the liquid into some new plastic drums. John is told to move the plastic drums to the company warehouse, about a mile down the highway, and to get rid of the dirty rags in the dumpster behind the office.

**Comment:** Medico's waste is substantial enough (more than 220 lbs. per month) that Medico must apply for an identification number as a hazardous waste generator and establish a manifest system for tracking hazardous waste. Medico must label the barrels correctly.

In addition, because Medico keeps its waste more than 90 days, it is considered a TSD storage site, and must obtain an operating permit from the EPA. TSD operators must provide training to their workers, have a written maintenance plan, and have a written emergency plan.

The appropriateness of substituting a plastic container for a metal drum depends upon the specific hazardous waste and the design of the container. In any event, however, labeling is required.

Transporting the hazardous material on the local roadways would require Medico to register as a transporter, and would require proper driver training.

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**Problem 3**

Mark is an equipment operator at the Strawberry Fields hazardous waste site. On one section of the site is a cluster of buried drums. Although the drums are not labeled and have not been tested, samples of the soil near the drums show heavy concentrations of arsenic and lead.

Eventually the contaminated soil will be treated on the waste site, but the treatment equipment has not been set up yet. The job superintendent is anxious to get to the buried drums and tells Mark to excavate the area. A second equipment operator, Jim, will haul the soil to a temporary storage pile on a marshy portion at the edge of the site about a mile away, about 300 yards from some farmhouses.

**Comment:** Even though this is a hazardous waste site governed by CERCLA, stockpiling the contaminated soil in an area where toxic materials may leach into the ground water and pollute the water supply may violate state programs developed under the Safe Drinking Water Act.

**Problem 4**

Curtis lives near the Videotex Co. factory where magnetic tape is made. He has heard rumors about the chemicals used in the manufacturing process. He has always worried about what materials may be stored there, and would like to know more information.

**Comment:** Under the Community Right-to-Know Act, Videotex is reporting regularly on the hazardous materials at its plant. Curtis should be able to review these reports at a government office. This may take a few phone calls to find out how these reports are handled in his state.

Curtis also would be interested to know that procedures for minimizing air contaminants from magnetic tape coating facilities are specially covered under a *NESHAP* standard issued pursuant to the Clean Air Act.

**Problem 5**

Steve is a truck driver for Tatum Trucking, which is registered with the EPA as a hazardous waste transporter. Tatum has a contract with a local dry cleaning plant to dispose of the plant's waste solvents. The actual disposal work is subcontracted to Kane Chemical Treatment, which operates under an EPA hazardous waste disposal permit.

Steve has picked up this week's waste solvent, and needs to return empty barrels to the dry cleaning plant in a couple of days. But Joe Tatum is having financial problems, and is not paying his bills. Kane Chemical Treatment has refused to accept this shipment of waste solvent for disposal. Joe Tatum asks Steve to see what he can do to get rid of the solvent, and reminds him of the creek behind the warehouse.

**Comment:** The simple rule is that no one should discharge anything into a stream without a permit. Even though most of Steve's work is governed by RCRA or the Hazardous Materials Transportation Act, the specific task that his boss is suggesting would be a violation of the Clean Water Act. Steve shouldn't violate this law; if he wants to report the problem to the local authorities, the law includes protection against retaliation.

Note as well that improper disposal also would violate RCRA's requirement that waste materials be delivered only to approved TSD facilities. Furthermore, if Steve were to dispose of the material incorrectly, he would need to compound his error by falsifying the materials manifest to hide his wrongdoing.

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**PART C****APPLICATION OF  
SAFETY AND HEALTH  
REGULATIONS AT  
DOE FACILITIES**

The protections of the OSH Act and the OSHA standards generally apply to all workers employed by private employers. However, the OSH Act specifically does not apply to the federal or state governments and their employees.

How do OSHA regulations apply to private contractors performing work at federal government facilities? The general rule is that you are covered by OSHA when you are employed by a private company on a contract at a government facility. Most of the time, if you believe there is a safety violation, you or the union representative can call the federal OSHA office (or the state OSHA office where there is a state plan) and ask for an inspection.

However, Sec. 4(b)(1) of the OSH Act gives some federal agencies the option to establish their own safety and health program, displacing OSHA:

Sec. 4(b)(1) Nothing in [the OSH Act] shall apply to working conditions of employees with respect to which other Federal agencies . . . exercise statutory authority to prescribe or enforce standards or regulations affecting occupational safety or health.

Under the Atomic Energy Act, 42 U.S.C. 2201(i), the Department of Energy has broad authority to establish standards for the operation of nuclear research and production facilities under its jurisdiction. Using this authority, the Department of Energy has implemented its own safety and health program at the nuclear research and production sites.

Although there have been proposals for OSHA to play a more active role in regulating safety and health at DOE facilities, under current policies it is the Department of Energy—and not OSHA—that enforces safety and health rules applicable to contractors and workers performing environmental restoration work.

As part of its contracting process, the Department of Energy includes a standard contract clause dealing with health and safety in its management and operation

contracts. This contract clause clearly establishes the contractor's responsibility for maintaining job safety at DOE facilities, and DOE's authority to enforce its health and safety policies. The standard health and safety clause applicable to government owned or leased facilities provides:

The contractor shall take all reasonable precautions in the performance of the work under this contract to protect the safety and health of employees and of members of the public and shall comply with all applicable safety and health regulations and requirements (including reporting requirements) of DOE. The [DOE] contracting officer shall notify the contractor, in writing, of any noncompliance . . . and the corrective action to be taken. After receipt of such notice, the contractor shall immediately take corrective action. The contractor shall submit a management program and implementation plan to [DOE] within 30 days after the date of award of this contract. In the event that the contractor fails to comply with said regulations or requirements of DOE, the contracting officer may . . . issue an order stopping all or any part of the work[.] 48 CFR 970.5204-2

On September 30, 1995, the Department of Energy issued a new safety and health policy, DOE Order 440.1, Worker Protection Management for DOE Federal and Contractor Employees. The health and safety rules applicable to DOE contractor and contractor employees were included in a section of the Order called the Contractor Requirements Document.

The Contractor Requirements Document declares that DOE contractors must comply with all the following OSHA standards:

29 CFR Part 1910 (General Industry Standards, including the hazardous waste operations standard and employee access to medical records standard)

29 CFR Part 1926 (Construction)

29 CFR Part 1915 (Shipyards)

29 CFR Part 1917 (Marine terminals)

29 CFR Part 1918 (Longshoring)

29 CFR Part 1928 (Agriculture)

Because DOE has adopted the OSHA safety and health standards for its own use, the instruction you are receiving about the OSHA safety and health standards generally applies to DOE facilities as well. Under the DOE Order, your contractor at a DOE facility must provide you with reasonable access to current copies of these OSHA safety standards for your review. Although the DOE essentially has adopted the substance of the major OSHA standards, its enforcement procedures are slightly different.

**Contractor  
Requirements  
Document**

The Contractor Requirements Document found within Order No. 440.1 includes the following requirements for providing health and safety information to employees, and for insuring contractor compliance with job safety and health rules:

**Worker Protection  
Management for DOE  
Contractor Employees  
(DOE Order 440.1)**

The contractor shall comply with the requirements contained herein.

1. Implement a written worker protection program that:
  - a. Provides a place of employment free from recognized hazards that are causing or are likely to cause death or serious physical harm to employees; and
  - b. Integrates all requirements contained in this attachment and other related site-specific worker protection activities.
2. Establish written policy, goals, and objectives for the worker protection program.
3. Use qualified worker protection staff to direct and manage the worker protection program.
4. Assign worker protection responsibilities, evaluate personnel performance, and hold personnel accountable for worker protection performance.
5. Encourage employee involvement in the development of program goals, objectives, and performance measures and in the identification and control of hazards in the workplace.
6. Provide workers the right, without reprisal, to:
  - a. Accompany DOE worker protection personnel during workplace inspections;
  - b. Participate in activities provided for herein on official time;
  - c. Express concerns related to worker protection;

- d. Decline to perform an assigned task because of a reasonable belief that, under the circumstances, the task poses an imminent risk of death or serious bodily harm to that individual, coupled with a reasonable belief that there is insufficient time to seek effective redress through the normal hazard reporting and abatement procedures established in accordance with the requirements herein;
  - e. Have access to DOE worker protection publications, DOE-prescribed standards, and the organization's own worker protection standards or procedures applicable to the workplace;
  - f. Observe monitoring or measuring of hazardous agents and have access to the results of exposure monitoring;
  - g. Be notified when monitoring results indicate they were overexposed to hazardous materials; and
  - h. Receive results of inspections and accident investigations upon request.
- 7. Implement procedures to allow workers, through their supervisors, to stop work when they discover employee exposures to imminent danger conditions or other serious hazards. The procedure shall ensure that any stop work authority is exercised in a justifiable and responsible manner.
  - 8. Inform workers of their rights and responsibilities by appropriate means, including posting the appropriate DOE Worker Protection Poster in the workplace where it is accessible to all workers.
  - 9. Identify existing and potential workplace hazards and evaluate the risk of associated worker injury or illness [by analyzing facility and equipment designs and operating procedures; assessing worker exposures to harmful agents; and reporting accidents, injuries and illnesses.] . .
  - 10. Implement a hazard prevention/abatement process to ensure that all identified hazards are managed through final abatement or control...
  - 11. Provide workers, supervisors, managers, visitors, and worker protection professionals with worker protection training.
  - 12. Comply with the following worker protection requirements.
    - a. Title 29 of the Code of Federal Regulations (CFR), Part 1910, Occupational Safety and Health Standards
    - b. Title 29 CFR, Part 1915, Shipyard Employment
    - c. Title 29 CFR, Part 1917, Marine Terminals

- d. Title 29 CFR, Part 1918, Safety and Health Regulations for Longshoring
- e. Title 29 CFR, Part 1926, Safety and Health Regulations for Construction
- f. Title 29 CFR, Part 1928, Occupational Safety and Health Standards for Agriculture
- g. American Conference of Governmental Industrial Hygienists (ACGIH), threshold limit values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (most recent edition, as specified in the contract), when ACGIH TLVs are lower (more protective) OSHA Permissible Exposure Limits. [When ACGIH TLVs are used as exposure limits, DOE operations shall nonetheless comply with the other provisions of any applicable OSHA-expanded health standard.] The TLVs for exposures to laser emissions in the ACGIH Indices are excluded from this requirement.
- h. American National Standards Institute Z136.1, Safe Use of Lasers. [Only the exposure limits and technical requirements apply. Programmatic components of American National Standards Institute Z136.1 do not apply.]
- i. American National Standards Institute Z88.2, Practices for Respiratory Protection.

## Construction Safety

The Department of Energy's standard document has special requirements for construction contractors performing work covered under the Davis-Bacon Act.

- (1) Hazard Analyses. For each construction operation presenting hazards not experienced in previous project operations or for work performed by a different subcontractor, the construction contractor shall prepare a hazard analysis and have it approved prior to commencement of affected work. These analyses shall identify foreseeable hazards and planned protective measures, provide drawings and/or other documentation of protective measures that a Professional Engineer or other competent person is required to prepare, and define the qualifications of competent persons required for workplace inspections.
- (2) Worker Hazard Awareness. Workers shall be informed of foreseeable hazards and the required protective measures described within the approved hazard analysis prior to commencement of work on the affected construction operation.
- (3) workplace Inspections and Hazard Abatement. During periods of active construction, the construction contractor shall have a designated representative on site at all times. This individual shall conduct and document daily inspections of the workplace to identify and correct hazards and instances of noncompliance

with project safety and health requirements. If immediate corrective action is not possible or the hazard falls outside of project scope, the construction contractor shall immediately notify affected workers, post appropriate warning signs, implement needed interim control measures, and notify the construction manager of actions taken.

- (4) Project Safety and Health Plan. The construction contractor shall prepare and have approved prior to commencement of any on-site project work a written project safety and health plan that provides a proposal for implementing the above requirements. The construction contractor shall also designate the individual(s) responsible for on-site implementation of the plan, specify qualifications for those individuals, and provide a list of those project operations for which a hazard analysis is to be performed.

## **Industrial Hygiene and Occupational Medical Program**

DOE's policies require contractors to implement an aggressive site monitoring program to make certain that employee exposures are minimized. In addition, DOE requires contractors to implement an extensive medical surveillance program, including the following requirements:

### *a. Integration*

- (1) The establishment of a contractor occupational medical program shall be a basic worker protection requirement.
- (2) A formal, written contractor occupational medical program detailing the methods and procedures used to implement the occupational medical requirements necessary for worker protection and the promotion of a healthful work environment shall be established, maintained, reviewed, and updated.
- (3) The contractor occupational medical program shall provide occupational health services to contractor employees. The goal of these services shall be the earliest possible detection and mitigation of occupational illness and injury.
- (4) To carry out this goal, the contractor occupational medical professional staff shall participate as members of a worker protection team.

### *b. Implementation.*

The physician responsible for delivery of medical services shall be responsible for the planning and implementation of the occupational medical program.

c. Maintenance of a Healthful Work Environment.

(1) Occupational medical physicians and selected medical staff shall:

(a) Coordinate with other safety and health professionals (industrial hygienists, health physicists, safety specialists/managers) to identify work-related or work site hazards and their possible health risks to employees;

(b) Possess a current knowledge of actual or potential work-related hazards (physical, chemical, biological);

(c) Perform targeted examinations based on an up-to-date knowledge of work site risk;

(d) Identify potential or actual health effects resulting from work site exposures; and

(e) Communicate the results of health evaluations to management and to those responsible for mitigating work site hazards.

(2) Contractor management shall provide to the physician responsible for delivery of medical services:

(a) Employee job task and hazard analysis information;

(b) Summaries of potential work site exposures of employees prior to mandatory health examinations; and

(c) The opportunity to participate in worker protection team meetings and committees.

d. Employee Health Examinations.

(1) Health examinations shall be conducted by an occupational health examiner under the direction of a licensed physician in accordance with current sound and acceptable medical practices.

(2) The content of health examinations shall be the responsibility of the physician responsible for the delivery of medical services.

(3) The following classes of examinations are required for the purpose of providing initial and continuing assessment of employee health as determined by the physician responsible for delivery of medical services:

(a) preplacement in accordance with the Americans with Disabilities Act,

(b) qualification examinations,

(c) fitness for duty,

(d) medical surveillance and health monitoring,

(e) return to work health evaluations,

(f) termination examinations.

(4) The occupational medical department shall be informed of all job transfers and shall determine whether a medical evaluation is necessary.

(5) The physician responsible for the delivery of medical services or his/her designee shall inform contractor management of appropriate employee work restrictions.

e. *Monitored Care.*

(1) The occupational medical program shall be responsible for the review of all monitored care of ill and injured employees to maximize their recovery and safe return to work, and to minimize lost time and its associated costs.

(2) Contractor management shall notify the physician responsible for the delivery of medical services or his designee when an employee has been absent because of an injury or illness for more than 5 consecutive workdays or experiences excessive absenteeism.

f. *Employee Counseling and Health Promotion.*

The physician responsible for delivery of medical services shall:

(1) review and approve the medical aspects of contractor-sponsored or -supported employee assistance, alcohol, and other substance abuse rehabilitation programs;

(2) approve and coordinate all contractor-sponsored or -supported wellness programs; and

(3) ensure that immunization programs for blood-borne pathogens and biohazardous waste programs conform to OSHA regulations and Centers for Disease Control guidelines for those employees at risk to these forms of exposure.

g. *Medical Records.*

(1) An employee medical record shall be developed and maintained for each employee for which medical services are provided.

(2) The confidentiality of all employee medical records shall be observed.

(3) Employee medical records shall be adequately protected and stored permanently.

In summary, the DOE's policies regarding safety and health at the defense nuclear facilities are similar in most respects to your OSH rights working at private facilities. However, it is important that you and your union be familiar with DOE's procedures for addressing health and safety problems.

### **DOE CONTRACTOR EMPLOYEE PROTECTION PROGRAM**

In March, 1992 the Department of Energy adopted strong regulations protecting employees of DOE contractors who report problems with safety and health, mismanagement, fraud, or other problems. These "whistle blower" protections are part of a formal regulation, the "DOE Contractor Employee Protection Program," 10 CFR Part 706. The DOE policy also reinforces a worker's right to refuse unreasonably dangerous work. The provisions of this regulation are very similar to basic OSHA rights.

Reproduced below are key portions of the regulation that outline worker's basic rights under the program. Workers who feel they have been discriminated against (or their union representatives) must complain within 30 days of the event to the contractor, DOE, or a member of Congress. Providing notice to the union alone will not be sufficient to protect a worker's rights, if the union is unable to file a timely protest with the employer or DOE.

#### *10 CFR §708.3 Policy*

It is the policy of DOE that employees of contractors at DOE facilities should be able to provide information to DOE, to Congress, or to their contractors concerning violations of law, danger to health and safety, or matters involving mismanagement, gross waste of funds, or abuse of authority, to participate in proceedings conducted before Congress or pursuant to this part, and to refuse to engage in illegal or dangerous activities without fear of reprisal. Contractor employees who believe they have been subject to such reprisal may submit their complaints to DOE for review and appropriate administrative remedy as provided . . . in this part.

#### *10 C.F.R §708.4 Definitions*

. . . Discrimination or discriminatory acts mean(s) discharge, coercion, restraint, threats, intimidation, or other similar negative action taken against a contractor employee by a contractor, as a result of the employee's disclosure of

information, participation in proceedings, or refusal to engage in illegal or dangerous activities, as set forth in §708.5(a) of this part.

10 CFR §708.5 *Prohibition Against Reprisals*

- (a) A DOE contractor covered by this part may not discharge or in any manner demote, reduce in pay, coerce, restrain, threaten, intimidate, or otherwise discriminate against any employee because the employee (or any person acting pursuant to a request of the employee) has:
  - (1) Disclosed to an official of DOE, to a member of Congress, or to the contractor (including any higher tier contractor), information that the employee in good faith believes evidences:
    - (i) A violation of any law, rule, or regulation;
    - (ii) A substantial and specific danger to employees or public health or safety; or
    - (iii) Fraud, mismanagement, gross waste of funds, or abuse of authority;
  - (2) Participated in a Congressional proceeding or in a proceeding conducted pursuant to this part; or
  - (3) Refused to participate in an activity, policy or practice when
    - (i) Such participation:
      - (A) Constitutes a violation of a Federal health or safety law; or
      - (B) Causes the employee to have a serious reasonable apprehension of serious injury to the employee, other employees, or the public due to such participation, and the activity, policy, or practice causing the employee's apprehension of such injury:
        - (1) Is of such a nature that a reasonable person, under circumstances then confronting the employee, would conclude there is a bona fide danger of an accident, injury, or serious impairment of health or safety resulting from participation in the activity, policy or practice; and
        - (2) The employee is not required to participate in such dangerous activity, policy, or practice because of the nature of his or her employment responsibilities;
      - (ii) The employee, before refusing to participate in the activity, policy or practice has sought from the contractor and has been unable to obtain a correction of the violation or dangerous activity, policy or practice; and

- (iii) The employee, within 30 days following such refusal, discloses to an official of DOE, a member of Congress, or the contractor, information regarding the violation or dangerous activity, policy or practice, and explaining why he has refused to participate in the activity.
- (b) An employee disclosure, participation, or refusal described in §708.5(a)(1), (2), or (3) shall be subject to this part only if it relates to activities alleged to have occurred under work performed by the contractor for DOE. This part is not intended to override any other provision or requirement of any regulation pertaining to Restricted Data, national security information, or any other classified or sensitive information[.]

10 CFR 708.13 *Communication of Program to Contractor Employees*

- (a) All contractors covered by this part shall inform their employees of the applicability of the DOE Contractor Employee Protection Program, including identification of the DOE offices to which a protected disclosure can be made and identification of appropriate points of contact for initiating employment-reprisal complaints.
- (b) The information required in paragraph (a) of this section shall be prominently posted in conspicuous places at the contractor work site, in all places where notices are customarily posted[.]

## CONCLUSION

DOE's program prohibiting retaliation against workers who report problems at DOE facilities, or who refuse to perform unreasonably hazardous work, should provide you with important protections. It is important that you know your rights, and exercise them.

**PART D****SAFETY AND HEALTH PROTECTIONS FOR GOVERNMENT EMPLOYEES**

Government workers are exposed to the full range of hazards that face workers in private industry. Government employees work in hospitals and schools, they are responsible for public safety and maintaining public works, they inspect mines, food plants, construction projects, factories, etc. A large portion of the American work force is employed directly by agencies of government, and there is an obvious need to provide effective safety and health programs for their protection.

Even though there is no doubt about the hazards that confront government employees at both the federal and state level, government employees often have much less protection than workers in the private sector because government employees are not directly covered by OSHA standards.

Although the protections of the OSH Act and the OSHA standards apply generally to “employees” of “employers,” government employees are specifically excluded from coverage because, under the Definitions in the Act,

“employer” means a person engaged in a business affecting commerce who has employees, but does not include the United States or any State or political subdivision of a State.

In short, the OSH Act and the OSHA health and safety standards directly protect only private-sector workers. Federal and state government employees are not covered directly by federal OSHA standards.

Why are government employees not covered directly by OSHA? When Congress originally enacted the OSH Act, it wanted to avoid a situation where one federal agency, the Labor Department, would be policing other agencies of government. Unfortunately, this means that the standards and enforcement procedures available for private-sector employees under the OSH Act generally are not available to government workers.

In this section, we look first at health and safety protections for federal government workers, and then for state and local government employees.

## FEDERAL EMPLOYEES

Several regulations address safety and health protections for federal employees. Figure 11-2 summarizes these regulations.

### Section 18 of the OSH Act

The need for health and safety protections for federal employees is specifically addressed in Section 18 of the OSH Act. Basically, the law simply provides that each federal agency is responsible for adopting a safety and health program for its own employees. The programs must be designed to provide protections equal to the OSHA standards.

Section 18 of the Act provides that:

- (a) It shall be the responsibility of the head of each Federal agency to establish and maintain an effective and comprehensive occupational safety and health program which is consistent with [the OSHA standards]. The head of each agency shall (after consultation with representatives of the employees thereof) --
  - (1) provide safe and healthful places and conditions of employment...;
  - (2) acquire, maintain, and require the use of safety equipment, personal protective equipment, and devices reasonably necessary to protect employees;
  - (3) keep adequate records of all occupational accidents and illness for proper evaluation and necessary corrective action;

Regulation	Description
Section 18 of the OSH Act	Requires federal agencies to adopt comprehensive safety and health programs consistent with OSHA standards.
Executive Order 12196	Directs federal agencies to implement safety and health programs, per Section 18, and establishes additional guidelines for agency programs.
OSHA Regulation 29 CFR 1960	Sets detailed minimum standards for agency safety and health programs, as determined by the Department of Labor.
Agency Guidelines or Orders	Establish safety and health standards for agency personnel, as well as enforcement mechanisms, consistent with Section 18, E.O. 12196, and OSHA regulation 29 C.F.R 1960.

**Figure 11-2.** A summary of the health and safety regulations for federal employees

(4) consult with the Secretary [of Labor] with regard to the adequacy ... of records; and

(5) make an annual report to the Secretary [of Labor] with respect to occupational accidents and injuries and the agency's [safety and health program].

**Executive Order 12196**

To implement the mandate of Section 18 of the OSH Act, in 1980 President Carter issued Executive Order 12196, "Occupational Safety and Health Programs for Federal Employees." The Executive Order applies throughout the federal government, except for military personnel and uniquely military operations.

The Executive Order directs federal agency heads to provide health and safety protections similar to the OSHA rights enjoyed by private sector employees, and directs the Secretary of Labor to provide leadership to these agencies in developing their safety and health programs. Under the Executive Order:

- Federal employees are entitled to the full protection of all the published OSHA standards, unless the Secretary of Labor has approved an alternative safety procedure.
- Just as private-sector employees are protected against discrimination under Section 11(c) of the OSH Act, the head of each federal agency also must establish procedures to protect federal employees who report safety violations from subsequent discrimination or reprisal.
- Federal agencies must create a system under which federal employees can report safety and health violations while keeping their identities confidential.
- Reports of imminently dangerous conditions by federal employees must be investigated within 24 hours, serious conditions must be investigated within 3 working days, and other complaints within 20 working days.
- A representative of the federal employees must be allowed to accompany the safety and health inspector.

The Executive Order authorizes federal agencies to establish joint labor and management safety committees, both at the national and field operations level, to monitor the agency's performance in implementing the safety and health program.

Although each federal agency retains primary responsibility for investigating complaints of safety violations at its work sites, the Executive Order provides that the Secretary of Labor may inspect federal government work sites when an agency fails to respond adequately to a complaint.

**Labor Department  
Guidelines for Federal  
Agency Safety and  
Health Plans**

The Labor Department has issued lengthy regulations to implement the Executive Order. These regulations for the Federal Employee Occupational Safety and Health (*FEOSH*) program, detailing the requirements imposed on each federal agency, are published at 29 CFR 1960. Major elements of the regulations are summarized here:

**Funding the Safety  
Program**

Each federal agency must designate an official who will be responsible for the safety and health program. In addition, the head of the agency is required to include in the agency budget sufficient funds to operate the occupational safety and health program, including funds needed for:

- Safety and health personnel, including administrative costs, training, PPE, etc.
- Abatement of safety and health hazards.
- Sampling and diagnostic tools, and laboratory analyses.
- Outside contracts to evaluate unhealthy conditions, if necessary.
- Promotional brochures, posters, films, etc.
- Technical resources such as books and periodicals.
- Medical surveillance programs for employees.

Providing Program  
Information to  
Employees

The regulation requires that the details of the agency's health and safety program must be made available to employees on request. In addition, each agency must develop and post in all workplaces the agency's version of the "OSHA poster," advising employees of (a) agency procedures for reporting safety and health violations, (b) the location where employees can get more information about the agency's safety program, and (c) relevant information about any safety and health committees.

Reports of Safety  
Violations

Under the Labor Department rules, any federal employee who believes that an unsafe or unhealthful working condition exists must have the right "and is encouraged" to report the condition to the appropriate agency official and ask for an inspection. With regard to employee confidentiality, upon the request of the individual making such report, no person shall disclose the name of the individual making the report or the names of individual employees referred to in the report, to anyone other than authorized representatives of the Secretary [of Labor].

Agencies are required to keep a log of all reports of safety and health violations. These logs must be kept at each agency establishment.

Agencies must investigate reports of unsafe conditions, and, where appropriate, issue a "Notice of an Unsafe or Unhealthful Working Condition." Abatement actions should be begun promptly.

Under limited circumstances, OSHA itself is authorized to conduct safety and health inspections. This may occur if:

- (1) There is no functioning joint safety and health committee; or
- (2) Half the membership of the safety and health committee asks for an OSHA investigation; or
- (3) An employee has reported an imminent danger, and OSHA determines that neither the agency nor the safety and health committee has responded to the employee's report.

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**Training**

As part of the Federal Employee Occupational Safety and Health program, federal agencies are required to provide extensive training to their work force. Top management of the agency must be given an orientation concerning the agency's enforcement responsibilities. Supervisors must be trained in their "line" responsibilities to insure compliance with safety and health regulations. Training must be provided for the agency's safety and health specialists, and inspectors.

Finally, both employees and union representatives must be provided with training in safety and health concerns specifically related to the jobs they perform.

**Recordkeeping and Reporting**

Like private employers, federal agencies must keep records of safety and health "incidents."

- Federal agencies must keep a log of all occupational injuries and illnesses, similar to the OSHA Form 200.
- Serious accidents resulting in fatalities or injuries to several persons must be reported to OSHA within 48 hours after their occurrence.
- Annually, each federal agency establishment must post a summary of the occupational injuries and illnesses.

**Asking for a NIOSH Health Hazard Evaluation**

As in private sector situations, the expertise of the NIOSH is available to help federal agencies find solutions to possible health hazards. However, there are some restrictions on who can request a NIOSH study. Requests for NIOSH investigations of problems facing federal employees can be made by:

- OSHA.
- The federal agency head.
- The joint safety and health committee, if half the members request such an investigation.
- The individual employees, at facilities where there is no safety and health committee.

**DOE Federal Employee Occupational Safety and Health Program**

Consistent with the Labor Department's regulations, the Secretary of the Department of Energy has published an Order detailing the DOE's FEOSH Program. The Department policy is published as DOE Order 3790.1B.

The policies for federal employees at DOE facilities should not be confused with the policies for DOE contractor employees at the same sites. These are covered under a separate series of Department orders, and generally are included in Department of Energy procurement contracts. The policies applicable to contractor personnel are covered elsewhere in this course material.

Federal employees are entitled to a copy of the DOE order on request, and are encouraged to obtain a copy for their own reference.

**STATE AND LOCAL GOVERNMENT EMPLOYEES**

In many respects, health and safety protections for state and local government employees have lagged behind protections for private and federal workers.

As noted above, the OSH Act itself, and the OSHA standards, apply only to private sector workers. Federal workers are entitled to receive comparable protections, pursuant to the OSH Act, Presidential Executive Order 12196, Labor Department regulations, and agency regulations and orders.

Unfortunately, the protections for state employees often are much weaker. Generally, the states can be divided into three categories in terms of the levels of protection provided to state and local government employees: They are states with comprehensive "state OSHA plans", states with limited "state OSHA plans", and states without "state OSHA plans."

**Comprehensive State OSHA Plans**

Under U.S. Department of Labor regulations, any state that chooses to have a comprehensive state OSHA for private sector employers must also provide the same level of protection for state government employees. This applies to about half the states. Under this policy, therefore, protections for state government employees in these state OSHA states are the same as for private

sector workers, and at least as protective as federal OSHA standards. In most of these states, the state OSHA protections will extend to local government employees as well.

**Limited State OSHA Plans**

Two states that do not have state OSHA plans, New York and Connecticut, have chosen to adopt a full set of safety and health standards applicable to state and local government employees. The state standards for government workers have been approved by federal OSHA as being the equivalent of federal OSHA standards. In these two states, state and local government employees can contact state government agencies for enforcement of standards, even though private sector workers would contact federal OSHA for enforcement of OSHA standards.

**No State OSHA Plans**

Except for New York and Connecticut, the remainder of the states that have not adopted comprehensive “state OSHA plans” do not have a consistent policy for protecting government employees. In many situations, there are simply no health and safety protections for state and local government workers at all, while in other cases there may be a variety of different policies. Health and safety protections for government employees in the states that have not adopted their own comprehensive state OSHA plans must be reviewed on a case-by-case basis.



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**SECTION 11- ASSIGNMENT SHEET**

1. List the 17 paragraphs of 29 CFR 1910.120.

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2. List the seven employee responsibilities found in the Occupational Safety and Health ACT (OSH Act).

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3. List the 11 rights an employee has under Section 11(c) of the OSH Act.

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4. Indicate what agency should be contacted in a state with a “state OSHA plan.”

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5. List the three conditions cited in 29 CFR 1977.120 that must be present for OSHA’s “right to refuse hazardous work” to apply.

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6. Using the OSHA Hazardous Waste Operations standard (29 CFR 1910.120), answer the following questions and identify the section where the answer is found.

What refresher training is required for hazardous waste workers?

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Section: \_\_\_\_\_

The OSHA standard requires initial training, site specific training, and refresher training. What are the seven elements that must be covered by the training?

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Section: \_\_\_\_\_

Generally, the hazardous waste workers are covered by OSHA's medical surveillance program requirements 29 CFR 1910.120(f)(2)(i). How frequently must employees be medically examined?

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Section: \_\_\_\_\_

Is the employer required to give the employee a copy of the doctor's written opinion?

Section: \_\_\_\_\_

7. Match the following environmental protection laws with the correct definition.

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|--|--|
| _____ Clean Air Act                          | a. Controls the introduction of pollutants into the nation's surface water.  |
| _____ Toxic Substances Control Act           |  |
| _____ Clean Water Act                        | b. Requires emergency planning, reporting, and notification requirements to protect the public in the event of a release of a hazardous substance. |
| _____ Community Right-to-Know                |  |
| _____ CERCLA                                 |  |
| _____ Resource Conservation and Recovery Act | c. Regulates the nation's drinking water.  |
| _____ Hazardous Material Transportation      | d. Regulates air emissions released into the environment from industry, consumer products, and automobiles.  |
| _____ Safe Drinking Water Act                | e. Commonly known as Superfund. Designed to identify and clean up those sites that pose a serious threat to human health.                          |
|  | f. Regulates the transportation of hazardous materials.  |
|  | g. "Cradle to grave" legislation.  |
|  | h. Requires that specific chemicals be tested and regulated to determine their health and environmental impact.                                    |



# HAZARDOUS WASTE WORKER

Section

**12**

Title

**SUPERFUND AND  
COMMUNITY RELATIONS**

## TRAINEE OBJECTIVES

After completing Section 12, you will be able to:

1. Define the following terms:

Feasibility study

Hazard ranking system

Preliminary assessment

Record of decision

Remedial action

Remedial design

Remedial investigation

Removal action

Site inspection

2. List the three groups the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) considers to be potentially responsible parties (PRPs).



**THE SUPERFUND PROGRAM**

The Comprehensive Environmental Response, Compensation and Liability Act (*CERCLA*)—commonly known as Superfund—is the nation’s environmental program for cleaning up abandoned and uncontrolled hazardous waste sites. Such sites are extremely diverse. Hazardous wastes come from many different sources, including:

1. Manufacturing – heavy metals like lead and mercury; chemicals, pesticides, and herbicides used for agriculture; and polychlorinated biphenyls (*PCBs*) used in electrical transformers and capacitors.
2. Small service industries – solvents and by-products from dry cleaning establishments, paint shops, printing operations, metal plating, and degreasing operations.
3. Specific industries – wood preserving, solvent recovery, oil reclaiming, and nuclear and radioactive operations.

*CERCLA* authorized the federal government to respond directly to releases or threatened releases of hazardous substances that could endanger public health, public welfare, or the environment. It provided for legal actions to be taken to force the parties responsible for causing the contamination to clean up the sites or reimburse the Superfund for the cost of the cleanup.

The first years of *CERCLA* were characterized by many lawsuits over the implementation and constitutionality of the statute. As a result, many companies were reluctant to become involved in the cleanup process. In addition, the Environmental Protection Agency (*EPA*) devoted much of its effort to developing procedures and requirements for carrying out the site cleanup process. Only ten sites had been cleaned up by early 1985. As a result, Congress demanded more and faster action. The result was the Superfund Amendments and Reauthorization Act (*SARA*) passed into law in 1986. This was Congress’ attempt to put more money to work at more sites.

**SARA**

SARA, a 5-year extension of CERCLA was signed into law on October 17, 1986. Some of the more important changes that SARA made to the CERCLA program include:

- More stringent clean-up standards.
- New and independent programs such as the Community-Right-To-Know Act.
- Guarantees of greater citizen input and involvement in remedy selection and clean-up activities.

SARA expired in 1991. Because Congress could not reach an agreement on changes, none were made. The law was extended through 1994 with a funding level of \$1.75 billion per year. In 1994, despite consensus on many provisions, Congress failed to reauthorize the Superfund law. The Superfund tax, made up of a corporate environmental income tax and petroleum and chemical feedstock excise taxes, expired in 1995. Current funding is continuing at the 1994 level.

**The Future**

Currently, there is great activity in Congress, with the Administration and EPA focused on the need for reform and reauthorization of Superfund. The major issue to be resolved is how to achieve protective clean-up levels without bankrupting the cost bearers. The EPA also has a set of administrative reforms aimed at improving efficiency and achieving greater involvement of states, communities, and tribal nations. Although no funding shortfall is expected for the next one to two years, any reauthorization of the law will have to address where the money will come from.

**The Program**

CERCLA and SARA, provide EPA with the authority and tools necessary to respond directly, or to compel *potentially responsible parties (PRPs)* to respond, to the release or threatened release of hazardous substances, pollutants, or contaminants. CERCLA created two parallel and complementary programs or processes aimed at achieving this goal.

The first program involves the creation of a trust fund known as the Hazardous Substance Superfund. This fund is used for site cleanups when no PRPs are found or when the PRPs do not agree to pay for the cleanup. In these situations, the EPA plays the leadership role, carrying out the site remediation program using the Army Corp of Engineers and private contractors to do the actual work and paying for the work with money from the trust fund. It also continues to search for the parties responsible for creating the waste site. If and when it finds them, it brings suit against them to recover the money spent on the cleanup. Any money recovered is returned to the trust fund.

The second program provides EPA with the authority to negotiate settlements or to issue orders to PRPs, directing them to undertake the necessary response actions and to pay for those actions. The program is called the Superfund Enforcement Process. When the PRPs agree to carry out the cleanup, no money comes out of the trust fund. It is a major goal of the EPA to encourage PRPs to clean up waste sites. However, reaching an agreement may be a long process because of the large number of PRPs involved at most sites.

CERCLA considers the following groups to be PRPs who may be financially responsible for the costs of the cleanup:

- Owners, operators – Current owners or operators of a facility, or owners or operators of a facility at the time of disposal of hazardous substances.
- Generators – Those who generated the hazardous substance or arranged for treatment or disposal of hazardous substances at a facility.
- Transporters – Those who accepted hazardous substances for transport to a facility they selected.

The number of parties considered potentially liable for waste site cleanups can range from a single party to as many as a few thousand. It can include large companies as well as small businesses, schools, municipalities, and individuals. However, the law does not require the EPA

to find and notify all the PRPs. EPA's performance to-date indicates that a relatively small number of PRPs at each site are notified of their potential liability and required to respond. EPA's guidance to its regions provides these guidelines:

- EPA will name only those PRPs for which EPA has sufficient evidence to support a liability claim.
- The total number of PRPs named should collectively have the financial resources to pay for the work to be performed.
- Consider naming the "largest manageable number of parties."

One of the more substantial liabilities that CERCLA may impose on a PRP is "strict, joint, and several" liability. Joint and several liability defines the scope of liability. It means each and every PRP at a site could possibly be held individually liable for the entire cost of the site cleanup. In short, if a single PRP generated hazardous wastes that were disposed of at a site now designated as a Superfund site, it alone might be held liable for all the cleanup costs.

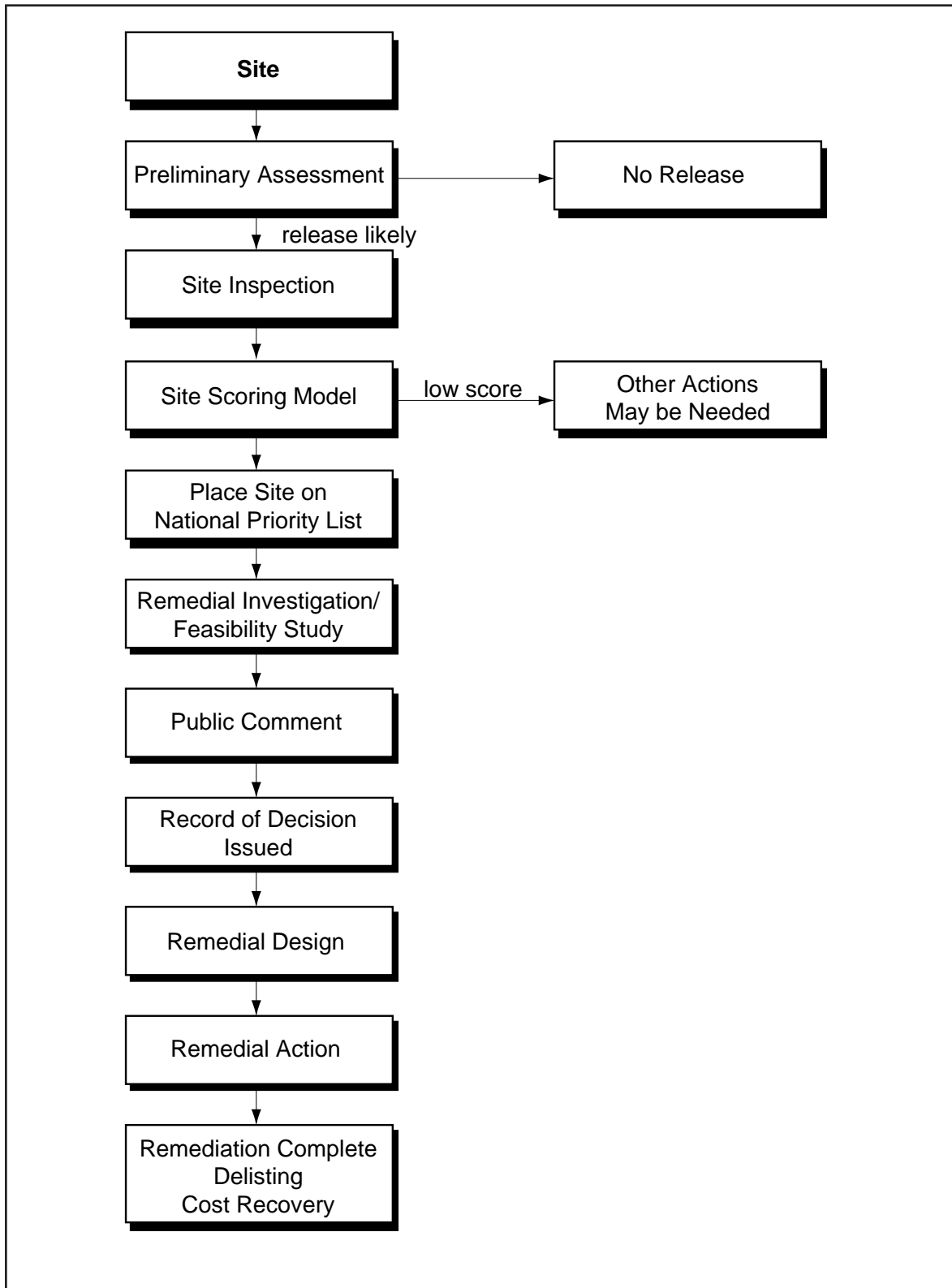
## **THE SUPERFUND SITE REMEDIATION PROCESS**

The Superfund site remediation process begins with identification of the hazardous waste site and concludes with cleanup of the hazardous waste. Procedures and standards for the cleanup of hazardous waste sites are set forth in the National Contingency Plan (*NCP*). The NCP establishes the framework for preliminary assessments, site inspections, the Hazard Ranking System, and requirements for remediation and removal. Figure 12-1 outlines the steps and sequence of the process.

### **Finding the Most Serious Sites**

A potential hazardous waste site might be discovered via:

- Citizen complaints
- Routine reports
- Regular inspections
- Accidents or emergencies, such as fire, explosion, and spills



**Figure 12-1.** Superfund site remediation process

Upon discovery, a site is logged into the Comprehensive Environmental Response, Compensation, and Liability Information System (*CERCLIS*). This is EPA's computerized inventory of Superfund sites. In the past, this inventory has contained nearly 40,000 sites. However, in 1995 the EPA removed approximately 24,000 sites where contamination had been removed and the site no longer posed a serious threat to human health or the environment.

Once a site has been logged into CERCLIS, the process to determine how hazardous a site is begins. The first step is to evaluate each site for placement on the National Priorities List (*NPL*), also called the Superfund List. This step is called the preliminary assessment.

#### Preliminary Assessment

A *preliminary assessment (PA)* is a review of available information and a reconnaissance visit to a site to determine if additional investigation or action is required. The lead agency, either the EPA regional office or a state agency, must complete a preliminary assessment within one year after listing a site on CERCLIS.

The preliminary assessment is based on readily available information, such as:

- Descriptions of site operations
- Regulatory history
- Area geology
- Demographic data
- Visual site observations

The goals of the preliminary assessment are to:

- Set priorities for site inspection
- Determine if a removal action is necessary
- Eliminate from further consideration those sites that do not threaten public health or the environment.

If a removal action is appropriate, it may proceed at the same time and during consideration of the site for placement on the NPL.

**Site Inspection**

If the preliminary assessment shows evidence of a significant or potential threat, EPA contractors or the state conduct a site inspection. A *site inspection (SI)* involves the following activities:

- Collecting samples.
- Gathering information to identify the waste handling practices at the site.
- Creating a description of known contaminants and the surrounding area.
- Locating potential human and environmental targets of contamination.

**Hazard Ranking System**

Data for listing (or not listing) a site on the NPL is collected during the preliminary assessment and site inspection phases. Using this information, a site is scored using the *Hazard Ranking System (HRS)*. The HRS is a number-based scoring system that evaluates the relative risks to human health and welfare and the environment posed by uncontrolled hazardous waste sites. It takes into consideration:

- The population at risk.
- The hazard potential of the hazardous substances at the site.
- The migration routes or pathways such as groundwater, surface water, air, and on-site exposure.

To be proposed for the NPL a site must be given an HRS score above 28.5. NPL sites are considered to be the most serious sites in the country, and are the ones to which EPA directs its highest priority efforts. Only sites on the NPL are eligible for Superfund financed remedial actions.

**Removal Actions**

A *removal action* (also called a removal) is the response to any release or substantial threat of release of any hazardous substance or any contaminant that may present an imminent and substantial danger to public health and welfare.

Removals may include actual removal of hazardous waste, but can also include an array of other activities to protect human health and the environment from the potential damage associated with a release or threat of a release. Such activities include:

- Monitoring
- Temporary evacuation of threatened populations
- Provision of alternate water supplies
- Erecting fences for security
- Waste removal

Removals can be used to respond to emergencies and accidental releases during transport or at operating facilities, as well as at abandoned sites. Removals are often the first response upon discovery of a hazardous waste site.

## **THE REMEDIAL PROGRAM**

Once on the NPL, a definite set of steps move the site toward final cleanup. Private industry and state government play large roles in conducting clean-up activities, but at NPL sites, the EPA approves remedies and oversees the work. Each site has a remedial project manager who is an EPA professional. Public outreach programs encourage citizens to comment and participate at each step in the process.

### **Remedial Investigation and Feasibility Study**

The *remedial investigation (RI)* is the first part of the site remediation process and determines the nature and extent of contamination at the site. Much more comprehensive and detailed than the initial site inspection, it involves extensive sampling and laboratory analysis. Waste types, site geology and hydrology, and specific health and environmental risks are examined.

The *feasibility study (FS)* uses the data generated by the remedial investigation to identify and evaluate alternative remedial clean-up actions.

The feasibility study process:

- Identifies potential clean-up alternatives.
- Screens and evaluates alternative remedies for the following:
  - Ability to meet public health, environmental, and cost-effectiveness requirements.
  - Engineering practicality and effectiveness.
  - Ability to be implemented in a reasonable time frame given available technologies.
- Eliminates inferior alternatives.
- Completes a detailed evaluation of the screened alternatives.

The feasibility study report describes the process and the results. A typical EPA remedial investigation/feasibility study requires up to two years to complete and costs \$1 to \$2 million or more. One NPL site may be subject to multiple remedial investigations and feasibility studies, each dealing with a different phase of the cleanup (called an operable unit). Personnel required for development of the remedial investigation/feasibility study are primarily those with technical training, except for support personnel involved in well-drilling and earth-moving.

## **Remedy Selection**

Once the remedial investigation and feasibility study are completed, the results are organized into reports. These reports become the basis for EPA clean-up decisions. EPA uses the following nine criteria for evaluation and comparison of final alternatives:

1. Overall protection of human health and the environment
2. Compliance with applicable or relevant and appropriate requirements
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume
5. Short-term effectiveness
6. Ability to be implemented
7. Cost
8. State acceptance
9. Community acceptance

After this evaluation and comparison, EPA selects a remedy. Remedy selection is a two-step process. First, the remedy selected by EPA is issued along with the remedial investigation/feasibility study for public comment. Second, based upon comments and any new information received, the government selects a final remedy. The final remedy is recorded in a document called the *record of decision (ROD)*. By law, that remedy must satisfy four requirements:

1. Protect human health and environment.
2. Satisfy the applicable or relevant and appropriate requirements.
3. Be cost-effective.
4. Utilize permanent solutions that destroy wastes to the maximum extent practicable.

### **Remedial Design and Remedial Action**

Once a record of decision is issued for a site, the *remedial design (RD)* and *remedial action (RA)* begins. The remedial design/remedial action are the combined stages of cleanup implementation. EPA may perform the remedial design/remedial action using money from Superfund, but if EPA pays for the remedial design/remedial action it may recover costs from the PRPs. Alternatively, PRPs may choose to perform the remedial design/remedial action to maintain control over the costs.

If the PRPs choose to implement the remedial design/remedial action, they must enter into an agreement with EPA. This agreement, called a consent decree, is a legally binding agreement executed by the Department of Justice.

Once a decision is made on whether PRPs will perform remediation or EPA will proceed using Superfund, remedial design follows. Remedial design is the process of preparing the technical drawings, specifications, and other supporting documents on the site's remedial action. Then the remedial design is used to obtain bids from

cleanup contractors. Once a contractor has been selected, the remedial action begins. It is at this point that laborers and other crafts will participate.

The remedial action is the actual work of cleaning up the hazardous waste. It may be as simple as removing and decontaminating drums, or pumping waste out of tanks and pits. Or it may be complex and take years. Cleaning polluted groundwater and dredging contaminated river bottoms are examples of complicated and costly long-term remedial actions.

In the 1980s in-place containment of the hazardous wastes was a fairly common remedial action. It was widely used at large landfills because the cost of destroying the large volumes of wastes present was very high.

In recent years, except for large landfills, in-place containment has lost favor. The EPA now favors destruction of the hazardous waste, preferably on-site.

The remedial action does not necessarily have to be done all at once or as one project. Many cleanups have been divided into what are called operable units. For example, at a site where there are drums and tanks of hazardous wastes that have leaked into and contaminated the soil and groundwater, there might be three cleanup stages or operable units as follows:

- Full removal of all hazardous wastes stored on site and dismantling and removal of drums, tanks, etc.
- Excavation and cleanup or removal of the contaminated soil.
- Installation of wells and a treatment plant so contaminated groundwater can be cleaned up.

**OPERATIONS AND  
MAINTENANCE**

Operation and maintenance activities are initiated after the cleanup is complete. For privately-funded cleanups, PRPs are responsible for operating and maintaining any treatment or containment systems associated with the site for the life of the remedy. At many sites where pump-and-treat facilities are installed the operation and maintenance period may be as long as 30 years.

**SUPERFUND  
PERFORMANCE**

The Superfund program dramatically improved hazardous waste disposal practices and focused attention on the adverse effects that former disposal practices had on human health and the environment. It also showed the necessity to protect drinking water resources and preserve the beauty of our rivers and bays.

EPA and PRPs realized that the lowest cost, long-term approach was to get the job done, rapidly and cost effectively. The specific gains that have been made include:

- Of the 15,500 active sites listed under CERCLA, 14,200 have site inspections ongoing or await final EPA decisions.
- Of the 1,300 sites on the NPL, remedies have been selected for 990, remedial actions have been initiated for 650, and 299 sites have completed construction.
- PRPs have conducted 55% of the design work; of the remainder, 35% is financed by the Trust Fund and 10% by federal facilities.
- Over 1,300 emergency removals have been carried out at 614 NPL sites and over 2,800 removal actions have been taken at 2,539 sites not listed on the NPL.

**COMMUNITY  
RELATIONS**

When the Superfund program was initially being developed under CERCLA, the hazardous waste clean-up effort was a source of great controversy. There were many reasons for this:

- The EPA was in its infancy, and many of its rules and regulations were just being developed.
- The public was outraged by what it considered to be life threatening hazards in its midst (Love Canal, for example).
- Parties considered potentially responsible for hazardous waste sites were involved in legal controversies, not only with the EPA but among themselves, as to the extent of their financial liability.
- Strong and aggressive environmental groups were claiming that many of the cleanups being carried out were not adequate or effective.

Early on, community relations were recognized as a crucial element of the cleanup effort. As explained by Lee Thomas, former EPA Administrator: "...where life, health, and economic survival may be at stake, good legislative intentions are not enough. The public demanded to know which sites would get priority treatment and how the clean-up process would work."

EPA's experience with the Superfund program has provided it with many valuable insights into the nature of public involvement in hazardous waste problems and, in turn, about the most useful approaches to community relations in Superfund. These have been incorporated into an EPA handbook, *Community Relations in Superfund*, issued in 1992.

It is important for hazardous waste workers to know about community relations requirements under Superfund in order to understand how cleanup decisions are made as well as how and why the public gets involved. Workers who are familiar with the community relations plan for their site can aid in developing a positive, mutually supportive relationship with the local community.

**Purpose and Goals of  
the Community  
Relations Program**

The public has a right to know about and influence decisions that affect their health, safety, and welfare. The Community Relations Program is a legal requirement under Superfund to ensure that right. It keeps interested citizens, especially those in the vicinity of a hazardous waste site, informed and involved in the decision-making process from planning through implementation of the final cleanup.

Public involvement has produced valuable information about hazardous waste sites and the history of their contamination. This input has improved the quality of cleanups, reduced costs, and helped identify the PRPs so that costs can be recovered.

Promoting cooperation between citizens and the government, and identifying and resolving conflicts are other major goals of the program. For example, those living in the vicinity of a hazardous waste site will want to see the problem resolved as quickly as possible. Yet they also want to feel confident that the safest remedy has been selected from among available options. Through community relations activities, the public is educated about the complex nature of the task and the length of time that may be required for investigation and community participation in the decision-making process. People tend to be more patient and cooperative in working with government when care has been taken to communicate reasonable and realistic expectations.

The public also tends to judge how well the technical work is being carried out by whether they feel they have been consistently and responsibly informed about the situation and whether their concerns have been considered in the cleanup decision. Research has shown that anger about what the public perceives as risky situations arises not so much from the actual risk as from people feeling that they have no control over what is happening to them. It has also been determined that this situation can be overcome by including the public in the decision-making process from the beginning.

**Overview of the  
Community Relations  
Program**

It is important to keep in mind, however, that although the states and the public can influence decisions and partake in the process, by law only EPA is empowered to make the final decision about cleanup options under consideration.

Community relations requirements are set forth in the 1990 National Oil and Hazardous Substances Pollution Contingency plan in SARA and in certain EPA policy documents. These requirements are applicable to all sites, EPA and state-lead, at which a Superfund response is being undertaken.

Experience with the Superfund program has shown EPA that:

- Those directly affected are most concerned.
- Small, informal communication efforts started early in the process and maintained throughout the cleanup are most successful for transmitting information.
- Preset formulas for a response action are not possible because technical problems and community concerns vary so greatly from site to site.
- Controversial issues and the concerns of the community need to be identified early on.

With these findings in mind, EPA has emphasized furthering two-way communication, addressing citizen concerns at the earliest opportunity, involving citizens in the decision-making process, and tailoring responses to each situation.

For short-term and emergency situations, referred to as removals, the community relations activities are limited. However, for all removals the EPA must fulfill certain basic requirements such as designation of an agency spokesperson and establishment of an administrative record. For removal actions lasting longer than 120 days, a formal Community Relations Plan must be prepared.

Laborers and related crafts will probably have limited involvement with removals. Normally they will not become involved in remedial responses until the actual site clean-up work begins in the remedial action stage. However, there are many steps that take place in the remedial process before the final cleanup is started. It's during certain of these steps, particularly when the remedy is selected, that concerns and controversy may develop. For this reason the EPA Community Relations policy requires that certain activities begin early in the remediation process and that the community relations efforts become an integral part of site activities. Outlined below are the steps required in this process.

## **COMMUNITY RELATIONS ACTIVITIES**

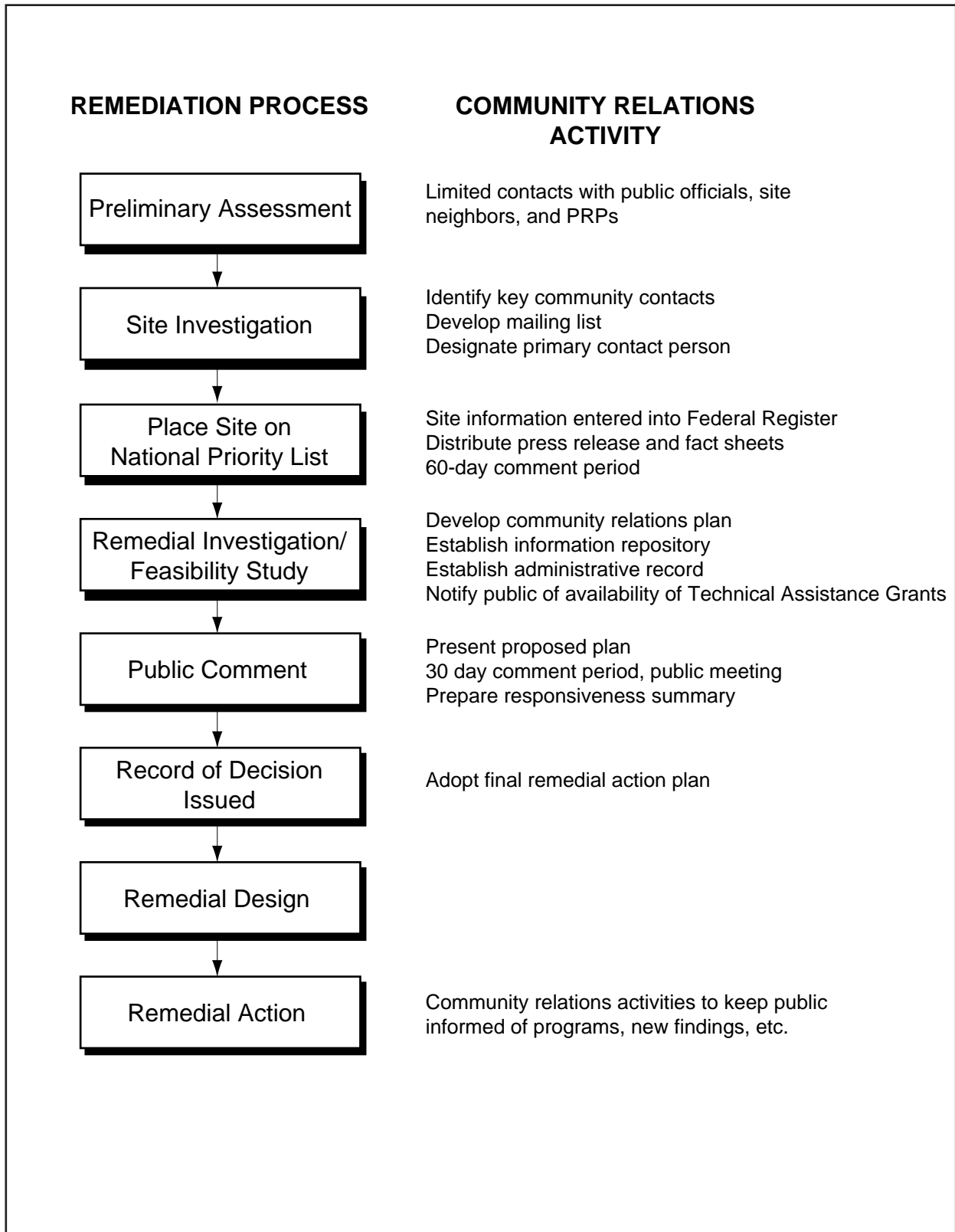
### **Preliminary Assessment/Site Inspection**

Specific community relations activities occur during each phase of the site remediation process. Figure 12-2 illustrates these activities.

During the preliminary assessment and site inspection phase, community relations activities are carefully planned so as not to raise unrealistic expectations about the risk and potential government response. Community relations activities at this stage include:

- Establish a limited community contact with elected officials, site neighbors, and PRPs to lay groundwork for the future.
- Identify key contacts in the community.
- Develop an agency mailing list.
- Designate a contact person.

When a site is placed on the NPL, public interest intensifies. Information about the site is entered into the Federal Register and a 60-day comment period is announced. EPA may distribute a press release and fact sheets explaining the Superfund process and how the public can submit comments.



**Figure 12-2.** Community relations activities during the Superfund process

**Prior to Remedial Investigation**

Before the remedial investigation begins community interviews are conducted. These interviews are the basis for constructing the Community Relations Plan that will outline how EPA will encourage citizen input and inform the community of progress made at the site. Interviews are conducted with the affected population and other interested parties such as elected officials, media, and PRPs. Substantial research on the site and community precedes these interviews, which may be carried out by the remedial project manager, community relations staff, or even enforcement staff and contractors.

The amount of interviewing depends on the extent and success of other interactions with the public. For instance, interviews may uncover the existence of citizen action or environmental groups that, with the press, should receive official announcements and other updates on the project. The interviews may show sufficient community interest to warrant workshops, seminars, or other educational programs. The information gathered during these interviews is the basis for development of the site-specific Community Relations Plan.

The Community Relations Plan (*CRP*) is developed after the interviews and normally includes:

- Site description and background
- History of community involvement at the site
- Community relations strategies
- Schedule of community relations activities
- List of contacts – local officials, interested parties

Prior to starting remedial investigation field activities, the EPA must establish an information repository to contain items developed, received, or published relative to site activity. The agency must also notify the public of the availability of a technical assistance grant (*TAG*) and include in the repository material that describes the *TAG* application process.

Upon commencement of the remedial investigation, the agency must establish an administrative record and publish a notice of its availability in a major local newspaper. The administrative record provides an opportunity for the public to be involved in the process of

selecting a remedy for the site. The public's comments must be written and submitted to the agency for incorporation into the record. This is necessary since any judicial review of the remedy will be limited to the administrative record.

**Remedial  
Investigation and  
Feasibility Study**

Most of the formal community relations requirements are met during the remedial investigation and feasibility study phase of the operation. Based on the remedial investigation and feasibility study, a proposed plan is developed for the cleanup. The proposed plan summarizes the remedial alternatives, identifies the preferred alternative, provides the rationale for selecting the preferred alternative, and documents the agency's comments. Release of the remedial investigation and feasibility study and proposed plan is the most critical phase of community relations activity. The public must understand the hazards present to understand why one clean-up proposal is preferable to another.

A number of the legal requirements under the Community Relations Program come into play at this point. Notification of the availability of the proposed plan and a brief summary must appear in a local paper of general circulation. The notice must also announce the public comment period during which both oral and written comments can be made.

The community must be given the opportunity for a public meeting at or near the facility at issue, and a transcript of the meeting must be placed in the administrative record. At the end of the comment period, the agency must prepare a responsiveness summary, which is a concise and complete summary of the public's comments and the agency's response to these comments. This summary becomes part of the record of decision package that is signed by EPA. With the signing of the record of decision, the remedy selection process becomes final.

**Remedial Action  
Phase**

With the start of the remedial action, site activity increases as construction of the selected remedy begins. While there are no formal community relations requirements during the remedial action, most sites continue activities to keep the community informed

about progress, new findings, etc. At most well-run sites the PRPs take the leadership role in this activity, working with the EPA's regional public relations representative and the construction contractor. Depending on site-specific conditions, any or all of the following tools might be employed to keep the public informed:

- Site office or trailer with videotapes, photographs, copies of program reports, etc.
- Periodic status meetings, open to the public, to provide opportunity for informal questions and answers
- Press releases, public information booklets
- Telephone hot-line
- Presentations to local community groups

Normally one person (with an alternate) is designated as the official spokesperson at a site undergoing cleanup. The person selected may be a representative of the EPA, the PRPs, the Army Corp of Engineers, or the contractor. To avoid spreading conflicting stories, it is best to refer any questions to the designated spokesperson. If there is any doubt who can best respond to inquiries, the safest choice is to refer the person inquiring to the EPA.

### **The Worker's Role**

Workers at a hazardous waste site may find that they attract questions. The public's knowledge about what goes on during a cleanup is still very limited and people are just naturally curious. This is particularly true if the site has had a negative history prior to resolving the method of cleanup.

If asked questions, workers should try to respond politely and responsibly with whatever information they're at liberty to share. Suggest other sources of information, particularly the official spokesperson, and acquaint them with the information repository, administrative record, public relations office, EPA hot-line, and regional office.

Remember, the public's primary concern is health and safety. When responding to these concerns emphasize the site's health and safety program and all the precautionary measures being taken to ensure a safe and healthy work place.

By law, contractors **cannot** speak for the government. The same applies to workers. Workers should not speak for the group unless authorized to do so. Refer inquiries to the official spokesperson. Common sense suggests that the subject of hazardous waste should not be treated lightly, especially with those who may be adversely affected.

The following guidelines are suggested for a worker's role in community relations:

- Respect the community's right to know and influence Superfund projects.
- Be a positive reflection of the union, co-workers, employer, and government through behavior and communication.
- Know what can be said and what cannot be said (i.e., speaking for the government).
- Be prepared with the information that can be talked about (i.e., work, training, and the union).
- Follow established practices when dealing with the media. Defer to an official spokesperson whenever possible and talk with the supervisor about how EPA would like media inquiries handled.
- Know what to do when faced with a problem. Workers can rely on the union, other labor resources, training instructors, and the EPA for help and guidance. Know where to refer others for further information.
- Carry out work responsibility, attending to personal health and safety, as well as that of the community.



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**SECTION 12 - ASSIGNMENT SHEET**

1. Define the following terms:

Feasibility study \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Hazard ranking system \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Preliminary assessment \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Record of decision \_\_\_\_\_  
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Remedial action \_\_\_\_\_  
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Remedial design \_\_\_\_\_  
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Remedial investigation \_\_\_\_\_  
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\_\_\_\_\_

Removal action \_\_\_\_\_  
\_\_\_\_\_

Site inspection \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

2. List the three groups the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) considers to be potentially responsible parties (PRPs).

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

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**APPENDIX 12-1****REPORTING A POSSIBLE HAZARDOUS WASTE PROBLEM IN YOUR COMMUNITY AND OBTAINING AN UPDATE ON THE STATUS OF A SITE**

Any citizen may report the existence of a hazardous waste site to the government by calling the Community Relations contact person at the nearest EPA regional office. When a site is reported it will be entered into a data base called the Comprehensive Environmental Response Compensation and Liability Act (CERCLIS). There are currently some 15,000 hazardous waste sites and possible sites listed in CERCLIS.

A preliminary assessment will be conducted to determine if state corrective action is being taken or enforcement under another piece of legislation (such as the Clean Air or Water Act). The site will also be inspected to determine if there is an immediate threat that must be addressed. If inspection confirms the existence of a significant hazard, the site will then undergo a site inspection and be given a hazard ranking score. This score will determine whether and where it is listed on the National Priorities List (NPL). Information about the status of a site can be obtained from the CERCLIS data base by calling the EPA Community Relations contact person or the national EPA Superfund Hotline number 1-800-424-9346.

**KEY CONTACTS AND SOURCES OF INFORMATION**

	Site 1	Site 2	Site 3
Site name and location:			
On-site contact name/phone:			
Nearest EPA regional office:			
Location of information repository:			
On-site union contact name/phone:			
Training center phone:			
Director's name/phone:			
Instructor's name/phone:			

**APPENDIX 12-2**  
**OSHA REGIONAL OFFICES**

**OSHA Region I**  
**(CT, MA, ME, NH, RI, VT)**  
JFK Building  
Room E340  
Boston, MA 02203  
Telephone (617) 565-9860

**OSHA Region VI**  
**(AR, LA, NM, OK, TX)**  
525 Griffin Street  
Room 602  
Dallas, TX 75202  
Telephone (214) 767-4731

**OSHA Region II**  
**(NJ, NY, PR\*, VI\*)**  
201 Varick Street  
Room 670  
New York, NY 10014  
Telephone (212) 337-2378

**OSHA Region VII**  
**(IA, KS, MO, NE)**  
City Center Square  
1100 Main Street, Suite 800  
Kansas City, MO 64105  
Telephone: (816) 426-5861

**OSHA Region III**  
**(DC\*, DE, MD, PA, VA, WV)**  
The Curtis Center - Suite 740 West  
170 S. Independence Mall West  
Philadelphia, PA 19106-3309  
Telephone (215) 861-4900

**OSHA Region VIII**  
**(CO, MT, ND, SD, UT, WY)**  
1999 Broadway  
Suite 1690  
Denver, CO 80202-5716  
Telephone (303) 391-5858

**OSHA Region IV**  
**(AL, FL, GA, KY, MS, NC, SC, TN)**  
61 Forsyth St. SW  
Atlanta, GA 30303  
Telephone (404) 562-2300

**OSHA Region IX**  
**(AS\*, AZ, CA, GU\*, HI, NV, TT\*)**  
71 Stevenson Street  
Room 420  
San Francisco, CA 94105  
Telephone (415) 975-4310

**OSHA Region V**  
**(IL, IN, MI, MN, OH, WI)**  
230 South Dearborn Street  
Room 3244  
Chicago, IL 60604  
Telephone (312) 353-2220

**OSHA Region X**  
**(AK, ID, OR, WA)**  
1111 Third Avenue  
Suite 715  
Seattle, WA 98101-3212  
Telephone (206) 553-5930

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**APPENDIX 12-3**  
**EPA REGIONAL OFFICE**

**EPA REGION I**  
**(CT, MA, ME, NH, RI, VT)**  
1 Congress Street  
Boston, MA 02114-2023  
Tel: (888) 372-7341

**EPA REGION II**  
**(NY, NJ, PR\*, VI\*)**  
290 Broadway  
New York, NY 10007  
Tel: (212) 637-3000

**EPA REGION III**  
**(DC\*, DE, MD, PA, VA, WV)**  
1650 Arch Street  
Philadelphia, PA 19103-2029  
Tel: (800) 438-2474

**EPA REGION IV**  
**(AL, FL, GA, KY, MS, NC, SC, TN)**  
Atlanta Federal Center  
61 Forsyth St. SW  
Atlanta, GA 30303-3104  
Tel: (800) 241-1754  
(404) 562-9900

**EPA REGION V**  
**(IL, IN, MI, MN, OH, WI)**  
77 West Jackson Blvd.  
Chicago, IL 60604  
Tel: (312) 353-2000  
(800) 621-8431

**EPA REGION VI**  
**(AR, LA, NM, OK, TX)**  
1445 Ross Avenue  
Suite 1200  
Dallas, TX 75202  
Tel: (214) 665-2200  
(800) 887-6063

**EPA REGION VII**  
**(IA, KS, MO, NE)**  
901 N. 5th Street  
Kansas City, KS 66101  
Tel: (913) 551-7003  
(800) 223-0425

**EPA REGION VIII**  
**(CO, MT, ND, SD, UT, WY)**  
999 18th Street  
Suite 500  
Denver, CO 80202-2405  
Tel: (303) 293-1603  
(800) 227-8917

**EPA REGION IX**  
**(AS\*, AZ, CA, CM\*, GU\*, HI, NV, TT\*)**  
75 Hawthorne Street  
San Francisco, CA 94105  
Tel: (415) 744-1500

**EPA REGION X**  
**(AK, ID, OR, WA)**  
1200 6th Avenue  
Seattle, WA 98101  
Tel: (206) 553-1200,  
(800)424-4EPA

Asterisk (\*) =

AS = American Samoa  
DC = District of Columbia  
PR = Puerto Rico  
VI = Virgin Islands

CM = Commonwealth of the N. Marianas Island  
GU = Guam  
TT = Trusted Territories





# HAZARDOUS WASTE WORKER

Section

## APPENDIXES

Title

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## APPENDIX A ACCESSING OSHA

### INTRODUCTION

OSHA and OSHA information may be accessed in one of three ways, depending upon the need:

1. OSHA emergency hot line
2. OSHA web site
3. OSHA publications

### OSHA EMERGENCY HOT LINE

OSHA provides a free hot line for reporting workplace safety or health emergencies and hazards that are life threatening. The service provides a 24-hour point of contact so that situations of imminent danger on the job can be reported to OSHA as soon as possible. The toll-free, 24-hour **emergency** telephone number is 1-800-321-OSHA.

Two kinds of service are available to assist callers to the OSHA hot line. The type of service will depend upon the time of the initiating call—daytime or after-hours.

#### Daytime Calls

For telephone calls received during normal working hours, the representative answering the call requests the following:

- Caller's name (optional)
- Daytime telephone number (also optional)
- Zip code (required)

The caller is asked to hold while the representative determines the appropriate area office and then transfers the call to that office. Normal working hours are 8 a.m. to 4:30 p.m. local time, Monday through Friday.

#### After-Hours Calls

After normal working hours are 4:30 p.m. to 8 a.m. local time, Monday through Friday, all day Saturday, Sunday and during official government holidays. Calls received during this time request the same information as daytime calls, with an additional request for the best time for a callback.

**OSHA WEB SITE**

The OSHA web site is a valuable resource for information on OSHA, regulations, events, etc., and is found at **[www.osha.gov](http://www.osha.gov)**. In particular, the site contains the “OSHA Workers’ Page.” This web page will guide you through the process of filing a complaint on-line. It can be found at:

**[www.osha.gov/as/opa/worker/index.html](http://www.osha.gov/as/opa/worker/index.html)**

To access the on-line complaint form directly, go to:

**[www.osha.gov/as/opa/worker/eComplaintForm.html](http://www.osha.gov/as/opa/worker/eComplaintForm.html)**

You can complete the form on-line and send it from your computer. Or you can print the form, fill it out, and fax or mail it. Your computer must have Adobe Acrobat Reader to view and print this form. If it does not, the “OSHA Workers’ Page” contains a link that will allow you to download the program for free.

It is important to note that on-line filing is **not** to be used for emergencies or hazards that are life threatening. In these situations contact your local OSHA regional office or call the hot line number 1-800-321-OSHA.

**OSHA  
PUBLICATIONS**

OSHA publications and information are available to the public. Many publications can be downloaded free from the web site, while others can be purchased from the U.S. Government Printing Office (GPO).

The OSHA CD-ROM is available through the GPO and contains the following publications:

- Complete text of all OSHA standards, including variances, interpretation of standards, and the preamble for OSHA 1910.1000, which contains the permissible workplace exposure limits.
- Chemical Information Manual.
- Field Operation Manual.
- OSHA Technical Manual.

To get a yearly subscription to the OSHA CD-ROM use order # 729-013-00000-5. The address and telephone number are:

SUPERINTENDENT OF DOCUMENTS  
U.S. Government Printing Office  
710 North Capitol Street, N.W.  
Washington, D.C. 20402  
Phone: (202) 512-1800



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## APPENDIX B

### HOW TO READ THE CODE OF FEDERAL REGULATIONS

#### INTRODUCTION

The Code of Federal Regulations (CFR) is the compilation of the general and permanent rules published in the *Federal Register* by the executive agencies and departments in the federal government. The CFR is divided into 50 titles that represent broad areas subject to federal regulation. Each title is revised at least once per calendar year, with groups of titles issued in different quarters as follows:

- Title 1-Title 16 as of January 1
- Title 17-Title 27 as of April 1
- Title 28-Title 41 as of July 1
- Title 42-Title 50 as of October 1

The CFR is kept up to date by the daily issues of the *Federal Register*. Using both the CFR and the *Federal Register*, the latest version of a rule can be determined.

Even after a title is reissued with changes, amendments may be made to the code before the next reissue date. To find amendments, consult the following lists:

- “Cumulative List of CFR Sections Affected” – issued monthly.
- “Cumulative List of Parts Affected” – appears daily in the *Federal Register*.

Both lists identify the page in the *Federal Register* which has the latest amendment of any given rule. (The *Federal Register* is numbered sequentially from January 1st to December 31st.)

#### HORIZONTAL AND VERTICAL STANDARDS

Standards are either horizontal or vertical in their application. Horizontal (or general) standards apply to all employers in all industries. Standards relating to fire protection, working surfaces, and first aid are examples of horizontal standards. Vertical (or particular) standards apply to one industry. For example, Subpart R of 1910 covers special industries, such as textiles, sawmills, and telecommunications.

**ORGANIZATION**

The information in a standard is organized in a specific hierarchy or structure:

1. Federal regulations are divided into titles.
2. A title is divided into chapters. Chapters usually bear the name of the issuing agency.
3. A chapter is divided into parts. Parts cover specific regulatory areas.
4. A part is divided into subparts.
5. A subpart is divided into sections.
6. A section is divided into paragraphs.
7. A paragraph is divided into levels of subparagraphs.

Figure 1 illustrates the structure of a regulation. Figure 2 lists the subparts of Part 1910.

**Title:** 29-Labor

**Chapter:** XVII (17) - OSHA

**Part:** 1910 - Occupational Safety and Health Standards

**Subpart:** H - Hazardous Materials

**Section:** 120 Hazardous Waste Operations and Emergency Response

**Paragraph:** (c) - Site characterization and analysis

**Subparagraph:** (4) Required information

**Subparagraph:** (i) Location and approximate size...

**29 CFR 1910.120 (c)(4) Required information.** The following information to the extent available shall be obtained by the employer prior to allowing employees to enter a site:

- (i) Location and approximate size of the site.
- (ii) Description of the response activity and/or the job task to be performed.
- (iii) Duration of the planned employee activity.

**Figure 1.** This figure shows the structure of the CFR.

Subpart A:	General
Subpart B:	Adoption and Extension of Established Federal Standards
Subpart C:	Adoption and Extension of Established Federal Standards
Subpart D:	Walking-Working Surfaces
Subpart E:	Means of Egress
Subpart F:	Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms
Subpart G:	Occupational Health and Environmental Control
Subpart H:	Hazardous Materials
Subpart I:	Personal Protective Equipment
Subpart J:	General Environmental Controls
Subpart K:	Medical and First Aid
Subpart L:	Fire Protection
Subpart M:	Compressed Gas and Compressed Air Equipment
Subpart N:	Materials Handling and Storage
Subpart O:	Machinery and Machine Guarding
Subpart P:	Hand and Portable Powered Tools and Other Hand-Held Equipment
Subpart Q:	Welding, Cutting, and Brazing
Subpart R:	Special Industries
Subpart S:	Electrical
Subpart T:	Commercial Diving Operations
Subpart U:	Reserved
Subpart V:	Reserved
Subpart W:	Reserved
Subpart X:	Reserved
Subpart Y:	Reserved
Subpart Z:	Toxic and Hazardous Substances

**Figure 2.** Part 1910 is made up of 24 subparts.

Each subpart is divided into sections. For example Subpart I - Personal Protective Equipment has eight sections:

- 1910.132 General requirements
- 1910.133 Eye and face protection
- 1910.134 Respiratory protection
- 1910.135 Head protection
- 1910.136 Occupational foot protection
- 1910.137 Electrical protective devices
- 1910.138 Hand protection
- 1910.139 Respiratory protection for M. tuberculosis

### Paragraph Numbering System

Paragraphs and subparagraphs use a specific numbering system. The following example is from 1910.134 Respiratory Protection:

#### **29 CFR 1910.134(h)(1)(i)**

**Maintenance and care of respirators.** This paragraph requires the employer to provide for the cleaning and disinfecting, storage, inspection, and repair of respirators used by employees.

**(1) Cleaning and disinfecting.** The employer shall provide each respirator user with a respirator that is clean, sanitary, and in good working order...

**(i)** Respirators used for the exclusive use of an employee shall be cleaned and disinfected as often as necessary...

Here is the breakdown:

<u>Title</u>	<u>Part</u>	<u>Section</u>	<u>Paragraph</u>	<u>Subparagraphs</u>
29	1910	134	h	1 and i

Paragraphs are identified by lower case letters in parentheses:

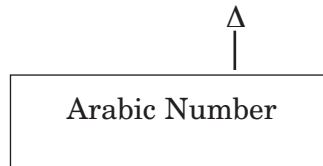
#### **29 CFR 1926.59 (h)**



Lower Case Alphabetical

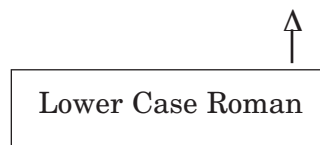
The first level of subparagraphs are identified by arabic numbers in parentheses:

**29 CFR 1910.134(h)(1)**



The second level of subparagraphs are identified by a roman numeral in parentheses:

**29 CFR 1910.134 (h)(1)(ii)**



## COLOR CODING

One way to simplify the use of the standards is to color code the standards book. Although there are many ways to do this, only one method will be shown. (Colors will vary according to personal choice.)

1. Highlight every section head full column width with green. Example:

**1910.134 Respiratory Protection**

2. Highlight every paragraph heading under 1910.134 with yellow. Example:

**(a) Permissible practice.**

**(b) Definitions.**

**(c) Respiratory protection program**

And so on through paragraph (o) Appendices

Color coding the standards has several advantages:

- Each paragraph acts as a sign post, showing where to get detailed information. Highlighting the paragraph makes it easier to find the appropriate information located between each paragraph.
- Helps to tell characters apart when they look alike. A lower case letter “l,” (a major paragraph) looks like the number “1” (an informational subheading). A lower case letter (i) (a major paragraph) looks the same as a lower case roman numeral (i) (an informational subheading).
- Reduces the confusion between a major paragraph and an informational subheading.
- Makes it easier to find OSHA information because the sections used most frequently are color coded.

Two other methods can be used to simplify finding information in the standards:

1. Use the subject index at the back of the standards to find a key word that describes a hazard.
2. Use the table of contents at the front of the standards to find section headings for quick referencing. Section headings are printed in the corner of every page of the standard, so they are easy to locate.

## **TERMINOLOGY**

To fully understand the CFR, it is important to know the meanings of certain words. Words such as “must,” “shall,” “required,” and “necessary” indicate requirements that must be carried out. Words such as “should,” “may,” “suggested,” and “recommended” indicate generally accepted good work practices.

**SUBPART H HAZARDOUS MATERIALS**  
**29 CFR 1910.120 Hazardous waste**  
**operations and emergency response.**

**(a) Scope, application, and definitions.**

**(1) Scope.**

This section covers the following operations, unless the employer can demonstrate that the operation does not involve employee exposure or the reasonable possibility for employee exposure to safety or health hazards:

(i) Clean-up operations required by a governmental body, whether Federal, state, local or other involving hazardous substances that are conducted at uncontrolled hazardous waste sites [including, but not limited to, the EPA's National Priority Site List (NPL), state priority site lists, sites recommended for the EPA NPL, and initial investigations of government identified sites which are conducted before the presence or absence of hazardous substances has been ascertained];

(ii) Corrective actions involving clean-up operations at sites covered by the Resource Conservation and Recovery Act of 1976 (RCRA) as amended (42 U.S.C. 6901 et seq);

(iii) Voluntary clean-up operations at sites recognized by Federal, state, local or other governmental bodies as uncontrolled hazardous waste sites;

(iv) Operations involving hazardous wastes that are conducted at treatment, storage, and disposal (TSD) facilities regulated by 40 CFR Parts 264 and 265 pursuant to RCRA; or by agencies under agreement with U.S.E.P.A. to implement RCRA regulations; and

(v) Emergency response operations for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazard.

**(2) Application.**

(i) All requirements of Part 1910 and Part 1926 of Title 29 of the Code of Federal Regulations apply pursuant to their terms to hazardous waste and emergency response operations whether covered by this section or not. If there is a conflict or overlap, the provision more protective of employee safety and health shall apply without regard to 29 CFR 1910.5 (c)(1).

(ii) Hazardous substance clean-up operations within the scope of paragraphs (a)(1)(i) through

(a)(1)(iii) of this section must comply with all paragraphs of this section except paragraphs (p) and (q).

(iii) Operations within the scope of paragraph (a)(1)(iv) of this section must comply only with the requirements of paragraph (p) of this section.

Notes and Exceptions: (A) All provisions of paragraph (p) of this section cover any treatment, storage or disposal (TSD) operation regulated by 40 CFR parts 264 and 265 or by state law authorized under RCRA, and required to have a permit or interim status from EPA pursuant to 40 CFR 270.1 or from a state agency pursuant to RCRA.

(B) Employers who are not required to have a permit or interim status because they are conditionally exempt small quantity generators under 40 CFR 261.5 or are generators who qualify under 40 CFR 262.34 for exemptions from regulation under 40 CFR parts 264, 265, and 270 ("excepted employers") are not covered by paragraphs (p)(1) through (p)(7) of this section. Excepted employers who are required by the EPA or state agency to have their employees engage in emergency response or who direct their employees to engage in emergency response are covered by paragraph (p)(8) of this section, and cannot be exempted by (p)(8)(i) of this section. Excepted employers who are not required to have employees engage in emergency response, who direct their employees to evacuate in the case of such emergencies and who meet the requirements of paragraph (p)(8)(i) of this section are exempt from the balance of paragraph (p)(8) of this section.

(C) If an area is used primarily for treatment, storage, or disposal, any emergency response operations in that area shall comply with paragraph (p)(8) of this section. In other areas not used primarily for treatment, storage, or disposal, any emergency response operations shall comply with paragraph (q) of this section. Compliance with the requirements of paragraph (q) of this section shall be deemed to be in compliance with the requirements of paragraph (p)(8) of this section.

(iv) Emergency response operations for releases of, or substantial threats of releases of, hazardous substances which are not covered by paragraph (a)(1)(i) through (a)(1)(iv) of this section must only comply with the requirements of paragraph (q) of this section.

**(3) Definitions.**

**“Buddy system”** means a system of organizing employees into work groups in such a manner that each employee of the work group is designated to be observed by at least one other employee in the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

**“Clean-up operation”** means an operation where hazardous substances are removed, contained, incinerated, neutralized, stabilized, cleared-up, or in any other manner processed or handled with the ultimate goal of making the site safer for people or the environment.

**“Decontamination”** means the removal of hazardous substances from employees and their equipment to the extent necessary to preclude the occurrence of foreseeable adverse health effects.

**“Emergency response”** or “responding to emergencies” means a response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance. Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area, or by maintenance personnel are not considered to be emergency responses within the scope of this standard. Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses.

**“Facility”** means (A) any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, storage container, motor vehicle, rolling stock, or aircraft, or (B) any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located; but does not include any consumer product in consumer use or any water-borne vessel.

**“Hazardous materials response (HAZMAT) team”** means an organized group of employees, designated by the employer, who are expected to perform work to handle and control actual or potential leaks or spills of hazardous substances requiring possible close approach to the substance. The team members perform

responses to releases or potential releases of hazardous substances for the purpose of control or stabilization of the incident. A HAZMAT team is not a fire brigade nor is a typical fire brigade a HAZMAT team. A HAZMAT team, however, may be a separate component of a fire brigade or fire department.

**“Hazardous substance”** means any substance designated or listed under paragraphs (A) through (D) of this definition, exposure to which results or may result in adverse effects on the health or safety of employees:

(A) Any substance defined under section 101(14) of CERCLA;

(B) Any biological agent and other disease-causing agent which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any person, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations in such persons or their offspring;

(C) Any substance listed by the U.S. Department of Transportation as hazardous materials under 49 CFR 172.101 and appendices; and

(D) Hazardous waste as herein defined.

**“Hazardous waste”** means

(A) A waste or combination of wastes as defined in 40 CFR 261.3, or

(B) Those substances defined as hazardous wastes in 49 CFR 171.8.

**“Hazardous waste operation”** means any operation conducted within the scope of this standard.

**“Hazardous waste site”** or “Site” means any facility or location within the scope of this standard at which hazardous waste operations take place.

**“Health hazard”** means a chemical, mixture of chemicals, or a pathogen for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term “health hazard” includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on

the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. It also includes stress due to temperature extremes. Further definition of the terms used above can be found in Appendix A to 29 CFR 1910.1200.

**“IDLH”** or “Immediately dangerous to life or health” means an atmospheric concentration of any toxic, corrosive, or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual’s ability to escape from a dangerous atmosphere.

**“Oxygen deficiency”** means that concentration of oxygen by volume below which atmosphere supplying respiratory protection must be provided. It exists in atmospheres where the percentage of oxygen by volume is less than 19.5 percent oxygen.

**“Permissible exposure limit”** means the exposure, inhalation, or dermal permissible exposure limit specified in 29 CFR Part 1910, Subparts G and Z.

**“Published exposure level”** means the exposure limits published in “NIOSH Recommendations for Occupational Health Standards” dated 1986 incorporated by reference, or if none is specified, the exposure limits published in the standards specified by the American Conference of Governmental Industrial Hygienists in their publication “Threshold Limit Values and Biological Exposure Indices for 1987-88” dated 1987 incorporated by reference.

**“Post emergency response”** means that portion of a emergency response performed after the immediate threat of a release has been stabilized or eliminated and clean-up of the site has begun. If post emergency response is performed by an employer’s own employees who were part of the initial emergency response, it is considered to be part of the initial response and not post emergency response. However, if a group of an employer’s own employees, separate from the group providing initial response, performs the clean-up operation, then the separate group of employees would be considered to be performing post-emergency response and subject to paragraph (q)(11) of this section.

**“Qualified person”** means a person with specific training, knowledge, and experience in the area for which the person has the responsibility and the authority to control.

**“Site safety and health supervisor or official”** means the individual located on a hazardous waste site who is responsible to the employer and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements.

**“Small quantity generator”** means a generator of hazardous wastes who in any calendar month generates no more than 1,000 kilograms (2,205 pounds) of hazardous waste in that month.

**“Uncontrolled hazardous waste site”** means an area where an accumulation of hazardous waste creates a threat to the health and safety of individuals or the environment or both. Some sites are found on public lands, such as those created by former municipal, county or state landfills where illegal or poorly managed waste disposal has taken place. Other sites are found on private property, often belonging to generators or former generators of hazardous waste. Examples of such sites include, but are not limited to, surface impoundments, landfills, dumps, and tank or drum farms. Normal operations at TSD sites are not covered by this definition.

#### **(b) Safety and health program.**

##### **Note to (b):**

Safety and health programs developed and implemented to meet other Federal, state, or local regulations are considered acceptable in meeting this requirement if they cover or are modified to cover the topics required in this paragraph. An additional or separate safety and health program is not required by this paragraph.

##### **(1) General.**

**(i)** Employers shall develop and implement a written safety and health program for their employees involved in hazardous waste operations. The program shall be designed to identify, evaluate, and control safety and health hazards, and provide for emergency response for hazardous waste operations.

**(ii)** The written safety and health program shall incorporate the following:

- (A) An organizational structure;
- (B) A comprehensive work plan;
- (C) A site-specific safety and health plan

which need not repeat the employer’s standard

operating procedures required in paragraph (b)(1)(ii)(f) of this section;

(D) The safety and health training program;

(E) The medical surveillance program;

(F) The employer's standard operating procedures for safety and health; and

(G) Any necessary interface between general program and site specific activities.

(iii) Site excavation. Site excavations created during initial site preparation or during hazardous waste operations shall be shored or sloped as appropriate to prevent accidental collapse in accordance with Subpart P of 29 CFR Part 1926.

(iv) Contractors and sub-contractors. An employer who retains contractor or sub-contractor services for work in hazardous waste operations shall inform those contractors, sub-contractors, or their representatives of the emergency response procedures and any potential fire, explosion, health, safety or other hazards of the hazardous waste operation that have been identified by the employer, including those identified in the employer's information program.

(v) Program availability. The written safety and health program shall be made available to any contractor or subcontractor or their representative who will be involved with the hazardous waste operation; to employees; to employee designated representatives; to OSHA personnel, and to personnel of other Federal, state, or local agencies with regulatory authority over the site.

**(2) Organizational structure part of the site program.**

(i) The organizational structure part of the program shall establish the specific chain of command and specify the overall responsibilities of supervisors and employees. It shall include, at a minimum, the following elements:

(A) A general supervisor who has the responsibility and authority to direct all hazardous waste operations.

(B) A site safety and health supervisor who has the responsibility and authority to develop and implement the site safety and health plan and verify compliance.

(C) All other personnel needed for hazardous waste site operations and emergency response and their general functions and responsibilities.

(D) The lines of authority, responsibility, and communication.

(ii) The organizational structure shall be reviewed and updated as necessary to reflect the current status of waste site operations.

**(3) Comprehensive work plan part of the site program**

The comprehensive work plan part of the program shall address the tasks and objectives of the site operations and the logistics and resources required to reach those tasks and objectives.

(i) The comprehensive work plan shall address anticipated clean-up activities as well as normal operating procedures which need not repeat the employer's procedures available elsewhere.

(ii) The comprehensive work plan shall define work tasks and objectives and identify the methods for accomplishing those tasks and objectives.

(iii) The comprehensive work plan shall establish personnel requirements for implementing the plan.

(iv) The comprehensive work plan shall provide for the implementation of the training required in paragraph (e) of this section.

(v) The comprehensive work plan shall provide for the implementation of the required informational programs required in paragraph (i) of this section.

(vi) The comprehensive work plan shall provide for the implementation of the medical surveillance program described in paragraph (f) of this section.

**(4) Site-specific safety and health plan part of the program.**

(i) General. The site safety and health plan, which must be kept on site, shall address the safety and health hazards of each phase of site operation and include the requirements and procedures for employee protection.

(ii) Elements. The site safety and health plan, as a minimum, shall address the following:

(A) A safety and health risk or hazard analysis for each site task and operation found in the work plan.

(B) Employee training assignments to assure compliance with paragraph (e) of this section.

(C) Personal protective equipment to be used by employees for each of the site tasks and operations being conducted as required by the personal protective equipment program in paragraph (g)(5) of this section.

(D) Medical surveillance requirements in accordance with the program in paragraph (f) of this section.

(E) Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.

(F) Site control measures in accordance with the site control program required in paragraph (d) of this section.

(G) Decontamination procedures in accordance with paragraph (k) of this section.

(H) An emergency response plan meeting the requirements of paragraph (l) of this section for safe and effective responses to emergencies, including the necessary PPE and other equipment.

(I) Confined space entry procedures.

(J) A spill containment program meeting the requirements of paragraph (j) of this section.

(iii) Pre-entry briefing. The site specific safety and health plan shall provide for pre-entry briefings to be held prior to initiating any site activity, and at such other times as necessary to ensure that employees are apprised of the site safety and health plan and that this plan is being followed. The information and data obtained from site characterization and analysis work required in paragraph (c) of this section shall be used to prepare and update the site safety and health plan.

(iv) Effectiveness of site safety and health plan. Inspections shall be conducted by the site safety and health supervisor or, in the absence of that individual, another individual who is knowledgeable in occupational safety and health, acting on behalf of the employer as necessary to determine the effectiveness of the site safety and health plan. Any deficiencies in the effectiveness of the site safety and health plan shall be corrected by the employer.

### **(c) Site characterization and analysis.**

#### **(1) General.**

Hazardous waste sites shall be evaluated in accordance with this paragraph to identify specific site hazards and to determine the appropriate safety and health control procedures needed to protect employees from the identified hazards.

#### **(2) Preliminary evaluation.**

A preliminary evaluation of a site's characteristics shall be performed prior to site entry by a qualified person in order to aid in the selection of appropriate employee protection methods prior to site entry. Immediately after initial site entry, a more detailed evaluation of the site's specific characteristics shall be performed by a qualified person in order to further identify existing site hazards and to further aid in the selection of the appropriate engineering controls and personal protective equipment for the tasks to be performed.

#### **(3) Hazard identification.**

All suspected conditions that may pose inhalation or skin absorption hazards, that are immediately dangerous to life or health (IDLH), or other conditions that may cause death or serious harm, shall be identified during the preliminary survey and evaluated during the detailed survey. Examples of such hazards include, but are not limited to, confined space entry, potentially explosive or flammable situations, visible vapor clouds, or areas where biological indicators such as dead animals or vegetation are located.

#### **(4) Required information.**

The following information to the extent available shall be obtained by the employer prior to allowing employees to enter a site:

(i) Location and approximate size of the site.

(ii) Description of the response activity and/or the job task to be performed.

(iii) Duration of the planned employee activity.

(iv) Site topography and accessibility by air and roads.

(v) Safety and health hazards expected at the site.

(vi) Pathways for hazardous substance dispersion.

(vii) Present status and capabilities of emergency response teams that would provide assistance to hazardous waste clean-up site employees at the time of an emergency.

(viii) Hazardous substances and health hazards involved or expected at the site, and their chemical and physical properties.

#### **(5) Personal protective equipment.**

Personal protective equipment (PPE) shall be provided and used during initial site entry in accordance with the following requirements:

(i) Based upon the results of the preliminary site evaluation, and ensemble of PPE shall be selected and used during initial site entry which will provide protection to a level of exposure below permissible exposure limits and published exposure levels for known or suspected hazardous substances and health hazards, and which will provide protection against other known and suspected hazards identified during the preliminary site evaluation. If there is no permissible exposure limit or published exposure level, the employer may use other published studies and information as a guide to appropriate personal protective equipment.

(ii) If positive-pressure self-contained breathing apparatus is not use as part of the entry ensemble, and if respiratory protection is warranted by the potential hazards identified during the preliminary site evaluation, an escape self-contained breathing apparatus of at least five minute's duration shall be carried by employees during initial site entry.

(iii) If the preliminary site evaluation does not produce sufficient information to identify the hazards or suspected hazards of the site, an ensemble providing protection equivalent to Level B PPE shall be provided as minimum protection, and direct reading instruments shall be used as appropriate for identifying IDLH conditions. (See Appendix B for a description of Level B hazards and the recommendations for Level B protective equipment.)

(iv) Once the hazards of the site have been identified, the appropriate PPE shall be selected and used in accordance with paragraph (g) of this section.

#### **(6) Monitoring.**

The following monitoring shall be conducted during initial site entry when the site evaluation produces information that shows the potential for ionizing radiation or IDLH conditions, or when the site information is not sufficient reasonably to eliminate these possible conditions:

(i) Monitoring with direct reading instruments for hazardous levels of ionizing radiation.

(ii) Monitoring the air with appropriate direct reading test equipment (i.e., combustible gas meters, detector tubes) for IDLH and other conditions that may cause death or serious harm (combustible or explosive atmospheres, oxygen deficiency, toxic substances).

(iii) Visually observe for signs of actual or potential IDLH or other dangerous conditions.

(iv) An ongoing air monitoring program in accordance with paragraph (h) of this section shall be implemented after site characterization has determined the site is safe for the start-up of operations.

#### **(7) Risk identification.**

Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances shall be identified. Employees who will be working on the site shall be informed of any risks that have been identified. In situations covered by the Hazard Communication Standard, 29 CFR 1910.1200, training required by that standard need not be duplicated.

Note to (c)(7): Risks to consider include, but are not limited to:

(a) Exposures exceeding the permissible exposure limits and published exposure levels.

(b) IDLH concentrations.

(c) Potential skin absorption and irritation sources.

(d) Potential eye irritation sources.

(e) Explosion sensitivity and flammability ranges.

(f) Oxygen deficiency.

#### **(8) Employee notification.**

Any information concerning the chemical, physical, and toxicologic properties of each substance known or expected to be present on site that is available to the employer and relevant to the duties an employee is expected to perform shall be made available to the affected employees prior to the commencement of their work activities. The employer may utilize information developed for the hazard communication standard for this purpose.

#### **(d) Site control.**

##### **(1) General**

Appropriate site control procedures shall be implemented to control employee exposure to hazardous substances before clean-up work begins.

##### **(2) Site control program**

A site control program for protecting employees which is part of the employer's site safety and health program required in paragraph (b) of this section shall be developed during the planning stages of a hazardous waste clean-up operation and modified as necessary as new information becomes available.

**(3) Elements of the site control program**

The site control program shall, as a minimum, include: A site map; site work zones; the use of a "buddy system"; site communications including alerting means for emergencies; the standard operating procedures or safe work practices; and , identification of the nearest medical assistance. Where these requirements are covered elsewhere they need not be repeated.

**(e) Training.****(1) General**

(i) All employees working on site (such as but not limited to equipment operators, general laborers, and others) exposed to hazardous substances, health hazards, or safety hazards and their supervisors and management responsible for the site shall receive training meeting the requirements of this paragraph before they are permitted to engage in hazardous waste operations that could expose them to hazardous substances, safety, or health hazards, and they shall receive review training as specified in this paragraph.

(ii) Employees shall not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility.

**(2) Elements to be covered**

The training shall thoroughly cover the following:

(i) Names of personnel and alternates responsible for site safety and health;

(ii) Safety, health and other hazards present on the site;

(iii) Use of personal protective equipment;

(iv) Work practices by which the employee can minimize risks from hazards;

(v) Safe use of engineering controls and equipment on the site;

(vi) Medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards; and

(vii) The contents of paragraphs (G) through (J) of the site safety and health plan set forth in paragraph (b)(4)(ii) of this section.

**(3) Initial training.**

(i) General site workers (such as equipment operators, general laborers, and supervisory personnel) engaged in hazardous substance removal or other activities which expose or

potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor.

(ii) Workers on site only occasionally for a specific limited task (such as, but not limited to, ground water monitoring, land surveying, or geophysical surveying) and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

(iii) Workers regularly on site who work in areas which have been monitored and fully characterized indicating that exposures are under permissible exposure limits and published exposure limits where respirators are not necessary , and the characterization indicates that there are no health hazards or the possibility of an emergency developing, shall receive a minimum of 24 hours of instruction off the site and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

(iv) Workers with 24 hours of training who are covered by paragraphs (e)(3)(ii) and (e)(3)(iii) of this section, and who become general site workers or who are required to wear respirators, shall have the additional 16 hours and two days of training necessary to total the training specified in paragraph (e)(3)(i).

**(4) Management and supervisor training.**

On-site management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations shall receive 40 hours initial training, and three days of supervised field experience [the training may be reduced to 24 hours and one day if the only area of their responsibility is employees covered by paragraphs (e)(3)(ii) and (e)(3)(iii)] and at least eight additional hours of specialized training at the time of job assignment on such topics as, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedure and techniques.

**(5) Qualifications for trainers.**

Trainers shall be qualified to instruct employees about the subject matter that is being presented in training. Such trainers shall have satisfactorily completed a training program for teaching the subjects they are expected to teach, or they shall have the academic credentials and instructional experience necessary for teaching the subjects. Instructors shall demonstrate competent instructional skills and knowledge of the applicable subject matter.

**(6) Training certification.**

Employees and supervisors that have received and successfully completed the training and field experience specified in paragraphs (e)(1) through (e)(4) of this section shall be certified by their instructor or the head instructor and trained supervisor as having successfully completed the necessary training. A written certificate shall be given to each person so certified. Any person who has not been so certified or who does not meet the requirements of paragraph (e)(9) of this section shall be prohibited from engaging in hazardous waste operations.

**(7) Emergency response.**

Employees who are engaged in responding to hazardous emergency situations at hazardous waste clean-up sites that may expose them to hazardous substances shall be trained in how to respond to such expected emergencies.

**(8) Refresher training.**

Employees specified in paragraph (e)(1) of this section, and managers and supervisors specified in paragraph (e)(4) of this section, shall receive eight hours of refresher training annually on the items specified in paragraph (e)(2) and/or (e)(4) of this section, any critique of incidents that have occurred in the past year that can serve as training examples of related work, and other relevant topics.

**(9) Equivalent training.**

Employers who can show by documentation or certification that an employee's work experience and/or training has resulted in training equivalent to that training required in paragraphs (e)(1) through (e)(4) of this section shall not be required to provide the initial training requirements of those paragraphs to such employees. However, certified employees or employees with equivalent training new to a site shall receive appropriate, site specific training before site entry and have appropriate supervised field experience at the new site. Equivalent

training includes any academic training or the training that existing employees might have already received from actual hazardous waste site work experience.

**(f) Medical surveillance.****(1) General.**

Employers engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section and not covered by (a)(2)(iii) exceptions and employers of employees specified in paragraph (q)(9) shall institute a medical surveillance program in accordance with this paragraph.

**(2) Employees covered.**

The medical surveillance program shall be instituted by the employer for the following employees:

(i) All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;

(ii) All employees who wear a respirator for 30 days or more a year or as required by § 1910.134;

(iii) All employees who are injured, become ill, or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation; or

(iv) Members of HAZMAT teams.

**(3) Frequency of medical examinations and consultations.**

Medical examinations and consultations shall be made available by the employer to each employee covered under paragraph (f)(2) of this section on the following schedules:

(i) For employees covered under paragraphs (f)(2)(i), (f)(2)(ii), and (f)(2)(iv):

(A) Prior to assignment;

(B) At least once every twelve months for each employee covered unless the attending physician believes a longer interval (not greater than biennially) is appropriate;

(C) At termination of employment or reassignment to an area where the employee would not be covered if the employee has not had an examination within the last six months;

(D) As soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation;

(E) At more frequent times, if the examining physician determines that an increased frequency of examination is medically necessary.

(ii) For employees covered under paragraph (f)(2)(iii) and for all employees including those of employers covered by paragraph (a)(1)(v) who may have been injured, received a health impairment, developed signs or symptoms which may have resulted from exposure to hazardous substances resulting from an emergency incident, or exposed during an emergency incident to hazardous substances at concentrations above the permissible exposure limits or the published exposure levels without the necessary personal protective equipment being used:

(A) As soon as possible following the emergency incident or development of signs or symptoms;

(B) At additional times, if the examining physician determines that follow-up examinations or consultations are medically necessary.

**(4) Content of medical examinations and consultations.**

(i) Medical examinations required by paragraph (f)(3) of this section shall include a medical and work history (or updated history if one is in the employee's file) with special emphasis on symptoms related to the handling of hazardous substances and health hazards, and to fitness for duty including the ability to wear any required PPE under conditions (i.e., temperature extremes) that may be expected at the work site.

(ii) The content of medical examinations or consultations made available to employees pursuant to paragraph (f) shall be determined by the attending physician. The guidelines in the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (See Appendix D, Reference #10) should be consulted.

**(5) Examination by a physician and costs.**

All medical examinations and procedures shall be performed by or under the supervision of a licensed physician, preferably one

knowledgeable in occupational medicine, and shall be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

**(6) Information provided to the physician.**

The employer shall provide one copy of this standard and its appendices to the attending physician, and in addition the following for each employee:

(i) A description of the employee's duties as they relate to the employee's exposures.

(ii) The employee's exposure levels or anticipated exposure levels.

(iii) A description of any personal protective equipment used or to be used.

(iv) Information from previous medical examinations of the employee which is not readily available to the examining physician.

(v) Information required by § 1910.134.

**(7) Physician's written opinion.**

(i) The employer shall obtain and furnish the employee with a copy of a written opinion from the attending physician containing the following:

(A) The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response, or from respirator use.

(B) The physician's recommended limitations upon the employee's assigned work.

(C) The results of the medical examination and tests if requested by the employee.

(D) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(ii) The written opinion obtained by the employer shall not reveal specific findings or diagnoses unrelated to occupational exposure.

**(8) Recordkeeping.**

(i) An accurate record of the medical surveillance required by paragraph (f) of this section shall be retained. This record shall be retained for the period specified and meet the criteria of 29 CFR 1910.20.

(ii) The record required in paragraph (f)(8)(i) of this section shall include at least the following information:

(A) The name and social security number of the employee;

(B) Physician's written opinions, recommended limitations and results of examinations and tests;

(C) Any employee medical complaints related to exposure to hazardous substances;

(D) A copy of the information provided to the examining physician by the employer, with the exception of the standard and its appendices.

**(g) Engineering controls, work practices, and personal protective equipment for employee protection.**

Engineering controls, work practices, personal protective equipment, or a combination of these shall be implemented in accordance with this paragraph to protect employees from exposure to hazardous substances and safety and health hazards.

**(1) Engineering controls, work practices and PPE for substances regulated in Subparts G and Z.**

(i) Engineering controls and work practices shall be instituted to reduce and maintain employee exposure to or below the permissible exposure limits for substances regulated by 29 CFR Part 1910, to the extent required by Subpart Z, except to the extent that such controls and practices are not feasible.

**Note to (g)(1)(i):** Engineering controls which may be feasible include the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material handling equipment. Work practices which may be feasible are removing all non-essential employees from potential exposure during opening of drums, wetting down dusty operations and locating employees upwind of possible hazards.

(ii) Whenever engineering controls and work practices are not feasible or not required, any reasonable combination of engineering controls, work practices, and PPE shall be used.

(iii) The employer shall not implement a schedule of employee rotation as a means of compliance with permissible exposure limits or dose limits except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

(iv) The provisions of 29 CFR, Subpart G, shall be followed.

**(2) Engineering controls, work practices and PPE for substances not regulated in Subpart G and Z.**

An appropriate combination of engineering controls, work practices and personal protective equipment shall be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards not regulated by 29 CFR Part 1910, Subparts G and Z. The employer may use the published literature and MSDS as a guide in making the employer's determination as to what level of protection the employer believes is appropriate for hazardous substances and health hazards for which there is no permissible exposure limit or published exposure level.

**(3) Personal protective equipment selection.**

(i) Personal protective equipment (PPE) shall be selected and used which will protect employees from the hazards and potential hazards they are likely to encounter as identified during the site characterization and analysis.

(ii) Personal protective equipment selection shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, the task-specific conditions and duration, and the hazards and potential hazards identified at the site.

(iii) Positive pressure self-contained breathing apparatus, or positive pressure air-line respirators equipped with an escape air supply, shall be used when chemical exposure levels present will create a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(iv) Totally-encapsulating chemical protective suits (protection equivalent to Level A protection as recommended in Appendix B) shall be used in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(v) The level of protection provided by PPE selection shall be increased when additional information on site conditions indicates that increased protection is necessary to reduce employee exposures below permissible exposure limits and published exposure levels for hazardous substances and health hazards. (See Appendix B for guidance on selecting PPE ensembles.)

Note to (g)(3): The level of employee protection provided may be decreased when additional information or site conditions show that decreased protection will not result in hazardous exposures to employees.

(vi) Personal protective equipment shall be selected and used to meet the requirements of 29 CFR Part 1910, Subpart I, and additional requirements specified in this section.

**(4) Totally-encapsulating chemical protective suits.**

(i) Totally-encapsulating suits shall protect employees from the particular hazards which are identified during site characterization and analysis.

(ii) Totally-encapsulating suits shall be capable of maintaining positive air pressure. (See Appendix A for a test method which may be used to evaluate this requirement.)

(iii) Totally-encapsulating suits shall be capable of preventing inward test gas leakage of more than 0.5 percent. (See Appendix A for a test method which may be used to evaluate this requirement.)

**(5) Personal protective equipment (PPE) program.**

A written personal protective equipment program, which is part of the employer's safety and health program required in paragraph (b) of this section or required in paragraph (p)(1) of this section and which is also a part of the site-specific safety and health plan shall be established. The PPE program shall address the elements listed below. When elements, such as donning and doffing procedures, are provided by the manufacturer of a piece of equipment and are attached to the plan, they need not be rewritten into the plan as long as they adequately address the procedure or element.

(i) PPE selection based on site hazards,

(ii) PPE use and limitations of the equipment,

(iii) Work mission duration,

(iv) PPE maintenance and storage,

(v) PPE decontamination and disposal,

(vi) PPE training and proper fitting,

(vii) PPE donning and doffing procedures,

(viii) PPE inspection procedures prior to, during, and after use,

(ix) Evaluation of the effectiveness of the PPE program, and

(x) Limitations during temperature extremes, heat stress and other appropriate medical considerations.

**(h) Monitoring.**

**(1) General.**

(i) Monitoring shall be performed in accordance with this paragraph where there may be a question of employee exposure to hazardous concentrations of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment so that employees are not exposed to levels which exceed permissible exposure limits, or published exposure levels if there are no permissible exposure limits, for hazardous substances.

(ii) Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of employee protection needed on site.

**(2) Initial entry.**

Upon initial entry, representative air monitoring shall be conducted to identify any IDLH condition, exposure over permissible exposure limits or published exposure levels, exposure over a radioactive material's dose limits or other dangerous conditions such as the presence of flammable atmospheres or oxygen-deficient environments.

**(3) Periodic monitoring.**

Periodic monitoring shall be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is indication that exposures may have risen over permissible exposure limits or published exposure levels since prior monitoring. Situations where it shall be considered whether the possibility that exposures have risen are as follows:

(i) When work begins on a different portion of the site.

(ii) When contaminants other than those previously identified are being handled.

(iii) When a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling).

(iv) When employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., a spill or lagoon).

**(4) Monitoring of high-risk employees.**

After the actual clean-up phase of any hazardous waste operations commences; for example, when soil, surface water or containers are moved or disturbed; the employer shall monitor those employees likely to have the highest exposures to hazardous substances and health hazards likely to be present above permissible exposure limits or published exposure levels by using personal sampling frequently enough to characterize employee exposures. If the employees likely to have the highest exposure are over permissible exposure limits or published exposure levels, then monitoring shall continue to determine all employees likely to be above those limits. The employer may utilize a representative sampling approach by documenting that the employees and chemicals chosen for monitoring are based on the criteria stated above.

Note to (h): It is not required to monitor employees engaged in site characterization operations covered by paragraph (c) of this section.

**(i) Informational programs.****(1) General.**

Employers shall develop and implement a program, which is part of the employer's safety and health program required in paragraph (b) of this section, to inform employees, contractors, and subcontractors (or their representative) actually engaged in hazardous waste operations of the nature, level and degree of exposure likely as a result of participation in such hazardous waste operations. Employees, contractors and subcontractors working outside of the operations part of a site are not covered by this standard.

**(j) Handling drums and containers.****(1) General.**

(i) Hazardous substances and contaminated soils, liquid, and other residues shall be handled, transported, labeled, and disposed of in accordance with this paragraph.

(ii) Drums and containers used during the clean-up shall meet the appropriate DOT, OSHA, and EPA regulations for the wastes that they contain.

(iii) When practical, drums and containers shall be inspected and their integrity shall be assured prior to being moved. Drums or

containers that cannot be inspected before being moved because of storage conditions (i.e., buried beneath the earth, stacked behind other drums, stacked several tiers high in a pile, etc.) shall be moved to an accessible location and inspected prior to further handling.

(iv) Unlabeled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

(v) Site operations shall be organized to minimize the amount of drum or container movement.

(vi) Prior to movement of drums or containers, all employees exposed to the transfer operation shall be warned of the potential hazards associated with the contents of the drums or containers.

(vii) U.S. Department of Transportation specified salvage drums or containers and suitable quantities of proper absorbent shall be kept available and used in areas where spills, leaks, or ruptures may occur.

(viii) Where major spills may occur, a spill containment program, which is part of the employer's safety and health program required in paragraph (b) of this section, shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred.

(ix) Drums and containers that cannot be moved without rupture, leakage, or spillage shall be emptied into a sound container using a device classified for the material being transferred.

(x) A ground-penetrating system or other type of detection system or device shall be used to estimate the location and depth of buried drums or containers.

(xi) Soil or covering material shall be removed with caution to prevent drum or container rupture.

(xii) Fire extinguishing equipment meeting the requirements of 29 CFR Part 1910, Subpart L shall be on hand and ready for use to control incipient fires.

**(2) Opening drums and containers.**

The following procedures shall be followed in areas where drums or containers are being opened:

(i) Where an airline respirator system is used, connections to the source of air supply shall be protected from contamination and the entire system shall be protected from physical damage.

(ii) Employees not actually involved in opening drums or containers shall be kept a safe distance from the drums or containers being opened.

(iii) If employees must work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operation shall be placed between the employee and the drums or containers being opened to protect the employee in case of accidental explosion.

(iv) Controls for drum or container opening equipment, monitoring equipment, and fire suppression equipment shall be located behind the explosion-resistant barrier.

(v) When there is a reasonable possibility of flammable atmospheres being present, material handling equipment and hand tools shall be of the type to prevent sources of ignition.

(vi) Drums and containers shall be opened in such a manner that excess interior pressure will be safely relieved. If pressure cannot be relieved from a remote location, appropriate shielding shall be placed between the employee and the drums or containers to reduce the risk of employee injury.

(vii) Employees shall not stand upon or work from drums or containers.

**(3) Material handling equipment.**

Material handling equipment used to transfer drums and containers shall be selected, positioned and operated to minimize sources of ignition related to the equipment from igniting vapors released from ruptured drums or containers.

**(4) Radioactive wastes.**

Drums and containers containing radioactive wastes shall not be handled until such time as their hazard to employees is properly assessed.

**(5) Shock sensitive wastes.**

As a minimum, the following special precautions shall be taken when drums and containers containing or suspected of containing shock-sensitive wastes are handled:

(i) All non-essential employees shall be evacuated from the area of transfer.

(ii) Material handling equipment shall be provided with explosive containment devices or protective shields to protect equipment operators from exploding containers.

(iii) An employee alarm system capable of being perceived above surrounding light and noise conditions shall be used to signal the

commencement and completion of explosive waste handling activities.

(iv) Continuous communications (i.e., portable radios, hand signals, telephones, as appropriate) shall be maintained between the employee-in-charge of the immediate handling area and both the site safety and health supervisor and the command post until such time as the handling operation is completed. Communication equipment or methods that could cause shock sensitive materials to explode shall not be used.

(v) Drums and containers under pressure, as evidenced by bulging or swelling, shall not be moved until such time as the cause for excess pressure is determined and appropriate containment procedures have been implemented to protect employees from explosive relief of the drum.

(vi) Drums and containers containing packaged laboratory wastes shall be considered to contain shock-sensitive or explosive materials until they have been characterized.

Caution: Shipping of shock sensitive wastes may be prohibited under U.S. Department of Transportation regulations. Employers and their shippers should refer to 49 CFR 173.21 and 173.50.

**(6) Laboratory waste packs.**

In addition to the requirements of paragraph (j)(5) of this section, the following precautions shall be taken, as a minimum, in handling laboratory waste packs (lab packs):

(i) Lab packs shall be opened only when necessary and then only by an individual knowledgeable in the inspection, classification, and segregation of the containers within the pack according to the hazards of the wastes.

(ii) If crystalline material is noted on any container, the contents shall be handled as a shock-sensitive waste until the contents are identified.

**(7) Sampling of drums and container contents.**

Sampling of containers and drums shall be done in accordance with a sampling procedure which is part of the site safety and health plan developed for and available to employees and others at the specific work site.

**(8) Shipping and transport.**

(i) Drums and containers shall be identified and classified prior to packaging for shipment.

(ii) Drum or container staging areas shall be kept to the minimum number necessary to identify and classify materials safely and prepare them for transport.

(iii) Staging areas shall be provided with adequate access and egress routes.

(iv) Bulking of hazardous wastes shall be permitted only after a thorough characterization of the materials has been completed.

**(9) Tank and vault procedures.**

(i) Tanks and vaults containing hazardous substances shall be handled in a manner similar to that for drums and containers, taking into consideration the size of the tank or vault.

(ii) Appropriate tank or vault entry procedures as described in the employer's safety and health plan shall be followed whenever employees must enter a tank or vault.

**(k) Decontamination.**

**(1) General.**

Procedures for all phases of decontamination shall be developed and implemented in accordance with this paragraph.

**(2) Decontamination procedures.**

(i) A decontamination procedure shall be developed, communicated to employees and implemented before any employees or equipment may enter areas on site where potential for exposure to hazardous substances exists.

(ii) Standard operating procedures shall be developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

(iii) All employees leaving a contaminated area shall be appropriately decontaminated; all contaminated clothing and equipment leaving a contaminated area shall be appropriately disposed of or decontaminated.

(iv) Decontamination procedures shall be monitored by the site safety and health supervisor to determine their effectiveness. When such procedures are found to be ineffective, appropriate steps shall be taken to correct any deficiencies.

**(3) Location.**

Decontamination shall be performed in geographical areas that will minimize the exposure of uncontaminated employees or equipment to contaminated employees or equipment.

**(4) Equipment and solvents.**

All equipment and solvents used for decontamination shall be decontaminated or disposed of properly.

**(5) Personal protective clothing and equipment.**

(i) Protective clothing and equipment shall be decontaminated, cleaned, laundered, maintained or replaced as needed to maintain their effectiveness.

(ii) Employees whose non-impermeable clothing becomes wetted with hazardous substances shall immediately remove that clothing and proceed to shower. The clothing shall be disposed of or decontaminated before it is removed from the work zone.

**(6) Unauthorized employees.**

Unauthorized employees shall not remove protective clothing or equipment from change rooms.

**(7) Commercial laundries or cleaning establishments.**

Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment shall be informed of the potentially harmful effects of exposures to hazardous substances.

**(8) Showers and change rooms.**

Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, they shall be provided and meet the requirements of 29 CFR 1910.141. If temperature conditions prevent the effective use of water, then other effective means for cleansing shall be provided and used.

**(1) Emergency response by employees at uncontrolled hazardous waste sites.**

**(1) Emergency response plan.**

(i) An emergency response plan shall be developed and implemented by all employers within the scope of paragraphs (a)(1)(i)-(ii) of this section to handle anticipated emergencies prior to the commencement of hazardous waste operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, OSHA personnel and other governmental agencies with relevant responsibilities.

(ii) Employers who will evacuate their employees from the danger area when an

emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan complying with section 1910.38(a) of this part.

**(2) Elements of an emergency response plan.**

The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following:

- (i) Pre-emergency planning.
- (ii) Personnel roles, lines of authority, and communication.
- (iii) Emergency recognition and prevention.
- (iv) Safe distances and places of refuge.
- (v) Site security and control.
- (vi) Evacuation routes and procedures.
- (vii) Decontamination procedures which are not covered by the site safety and health plan.
- (viii) Emergency medical treatment and first aid.
- (ix) Emergency alerting and response procedures.
- (x) Critique of response and follow-up.
- (xi) PPE and emergency equipment.

**(3) Procedures for handling emergency incidents.**

(i) In addition to the elements for the emergency response plan required in paragraph (1)(2) of this section, the following elements shall be included for emergency response plans:

(A) Site topography, layout, and prevailing weather conditions.

(B) Procedures for reporting incidents to local, state, and federal governmental agencies.

(ii) The emergency response plan shall be a separate section of the Site Safety and Health Plan.

(iii) The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.

(iv) The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(v) The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(vi) An employee alarm system shall be installed in accordance with 29 CFR 1910.165 to notify employees of an emergency situation; to

stop work activities if necessary; to lower background noise in order to speed communication; and to begin emergency procedures.

(vii) Based upon the information available at the time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

**(m) Illumination.**

Areas accessible to employees shall be lighted to not less than the minimum illumination intensities listed in Table H-102.1 while any work is in progress:

**TABLE H-102.1 - MINIMUM  
ILLUMINATION  
INTENSITIES IN FOOT-CANDLES**

Foot-Candles	Area or Operations
5	General site areas.
3	Excavation and waste areas, access ways, active storage areas, loading platforms, refueling, and field maintenance areas.
5	Indoors: Warehouses, corridors, hallways, and exit ways.
5	Tunnels, shafts, and general underground work areas. (Exception: Minimum of 10 foot-candles is required at tunnel and shaft heading during drilling, mucking, and scaling. MSHA approved cap lights shall be acceptable for use in the tunnel heading.
10	General shops (e.g., mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms.
30	First aid stations, infirmaries, and offices.

**(n) Sanitation at temporary work places.****(1) Potable water.**

(i) An adequate supply of potable water shall be provided on the site.

(ii) Portable containers used to dispense drinking water shall be capable of being tightly closed, and equipped with a tap. Water shall not be dipped from containers.

(iii) Any container used to distribute drinking water shall be clearly marked as to the nature of its contents and not used for any other purpose.

(iv) Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups shall be provided.

**(2) Nonpotable water.**

(i) Outlets for nonpotable water, such as water for fire fighting purposes, shall be identified to indicate clearly that the water is unsafe and is not to be used for drinking, washing, or cooking purposes.

(ii) There shall be no cross-connection, open or potential, between a system furnishing potable water and a system furnishing non-potable water.

**(3) Toilet facilities.**

(i) Toilets shall be provided for employees according to the Table H-102.2.

**TABLE H-102.2 - TOILET FACILITIES**

# of Employees	Minimum # of Facilities
20 or fewer	1
More than 20/ fewer than 200	1 toilet seat and 1 urinal per 40 employees
More than 200	1 toilet seat and 1 urinal per 50 employees

(ii) Under temporary field conditions, provisions shall be made to assure that at least one toilet facility is available

(iii) Hazardous waste sites not provided with a sanitary sewer shall be provided with the

following toilet facilities unless prohibited by local codes:

- (A) Chemical toilets;
- (B) Recirculating toilets;
- (C) Combustion toilets; or
- (D) Flush toilets.

(iv) The requirements of this paragraph for sanitation facilities shall not apply to mobile crews having transportation readily available to nearby toilet facilities.

(v) Doors entering toilet facilities shall be provided with entrance locks controlled from inside the facility.

**(4) Food handling.**

All food service facilities and operations for employees shall meet the applicable laws, ordinances, and regulations of the jurisdictions in which they are located.

**(5) Temporary sleeping quarters.**

When temporary sleeping quarters are provided, they shall be heated, ventilated, and lighted.

**(6) Washing facilities.**

The employer shall provide adequate washing facilities for employees engaged in operations where hazardous substances may be harmful to employees. Such facilities shall be in near proximity to the work site; in areas where exposures are below permissible exposure limits and published exposure levels and which are under the controls of the employer; and shall be so equipped as to enable employees to remove hazardous substances from themselves.

**(7) Showers and change rooms.**

When hazardous waste clean-up or removal operations commence on a site and the duration of the work will require six months or greater time to complete, the employer shall provide showers and change rooms for all employees exposed to hazardous substances and health hazards involved in hazardous waste clean-up or removal operations.

(i) Showers shall be provided and shall meet the requirements of 29 CFR 1910.141(d)(3).

(ii) Change rooms shall be provided and shall meet the requirements of 29 CFR 1910.141(e). Change rooms shall consist of two separate change areas separated by the shower area required in paragraph (n)(7)(i) of this section. One change area, with an exit leading off the work site, shall provide employees with a clean area where they can remove, store, and put on street clothing. The second area, with an exit to

the work site, shall provide employees with an area where they can put on, remove, and store work clothing and personal protective equipment.

(iii) Showers and change rooms shall be located in areas where exposures are below the permissible exposure limits and published exposure levels. If this cannot be accomplished, then a ventilation system shall be provided that will supply air that is below the permissible exposure limits and published exposure levels.

(iv) Employers shall assure that employees shower at the end of their work shift and when leaving the hazardous waste site.

**(o) New technology programs.**

(1) The employer shall develop and implement procedures for the introduction of effective new technologies and equipment developed for the improved protection of employees working with hazardous waste clean-up operations, and the same shall be implemented as part of the site safety and health program to assure that employee protection is being maintained.

(2) New technologies, equipment or control measures available to the industry, such as the use of foams, absorbents, adsorbents, neutralizers, or other means to suppress the level of air contaminants while excavating the site or for spill control, shall be evaluated by employers or their representatives. Such an evaluation shall be done to determine the effectiveness of the new methods, materials, or equipment before implementing their use on a large scale for enhancing employee protection. Information and data from manufacturers or suppliers may be used as part of the employer's evaluation effort. Such evaluations shall be made available to OSHA upon request.

**(p) Certain operations conducted under the Resource Conservation and Recovery Act of 1976 (RCRA).**

Employers conducting operations at treatment, storage, and disposal (TSD) facilities specified in paragraph (a)(1)(iv) of this section shall provide and implement the programs specified in this paragraph. See the "Notes and Exceptions" to paragraph (a)(2)(iii) of this section.

**(1) Safety and health program.**

The employer shall develop and implement a written safety and health program for employees involved in hazardous waste operations that shall be available for inspection by employees, their representatives, and OSHA personnel. The program shall be designed to identify, evaluate and control safety and health hazards in their facilities for the purpose of employee protection, to provide for emergency response meeting the requirements of paragraph (p)(8) of this section and to address as appropriate site analysis, engineering controls, maximum exposure limits, hazardous waste handling procedures and uses of new technologies.

**(2) Hazard communication program.**

The employer shall implement a hazard communication program meeting the requirements of 29 CFR 1910.1200 as part of the employer's safety and health program.

**Note to 1910.120.** The exemption for hazardous waste provided in § 1910.1200 is applicable to this section.

**(3) Medical surveillance program.**

The employer shall develop and implement a medical surveillance program meeting the requirements of paragraph (f) of this section.

**(4) Decontamination program.**

The employer shall develop and implement a decontamination procedure meeting the requirements of paragraph (k) of this section.

**(5) New technology program.**

The employer shall develop and implement procedures meeting the requirements of paragraph (o) of this section for introducing new and innovative equipment into the workplace.

**(6) Material handling program.**

Where employees will be handling drums or containers, the employer shall develop and implement procedures meeting the requirements of paragraphs (j)(1)(ii) through (viii) and (xi) of this section, as well as (j)(3) and (j)(8) of this section prior to starting such work.

**(7) Training program.**

(i) New employees. The employer shall develop and implement a training program, which is part of the employer's safety and health program, for employees exposed to the health hazards or hazardous substances at TSD operations to enable the employees to perform their assigned duties and functions in a safe and healthful manner so as not to endanger themselves or other employees. The initial

training shall be for 24 hours and refresher training shall be for eight hours annually. Employees who have received the initial training required by this paragraph shall be given a written certificate attesting that they have successfully completed the necessary training.

(ii) Current employees. Employers who can show by an employee's previous work experience and/or training that the employee has had training equivalent to the initial training required by this paragraph, shall be considered as meeting the initial training of this paragraph as to that employee. Equivalent training includes the training that existing employees might have already received from actual site work experience. Current employees shall receive eight hours of refresher training annually.

(iii) Trainers. Trainers who teach initial training shall have satisfactorily completed a training course for teaching the subjects they are expected to teach or they shall have the academic credentials and instruction experience necessary to demonstrate a good command of the subject matter of the courses and competent instructional skills.

**(8) Emergency response program.**

(i) Emergency response plan. An emergency response plan shall be developed and implemented by all employers. Such plans need not duplicate any of the subjects fully addressed in the employer's contingency planning required by permits, such as those issued by the U.S. Environmental Protection Agency, provided that the contingency plan is made part of the emergency response plan. The emergency response plan shall be a written portion of the employers safety and health program required in paragraph (p)(1) of this section. Employers who will evacuate their employees from the work site location when an emergency occurs and who do not permit any of their employees to assist in handling the emergency are exempt from the requirements of paragraph (p)(8) if they provide an emergency action plan complying with §1910.38(a) of this part.

(ii) Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following areas to the extent that they are not addressed in any specific program required in this paragraph:

(A) Pre-emergency planning and coordination with outside parties.

(B) Personnel roles, lines of authority, and communication.

(C) Emergency recognition and prevention

(D) Safe distances and places of refuge.

(E) Site security and control.

(F) Evacuation routes and procedures.

(G) Decontamination procedures.

(H) Emergency medical treatment and first aid.

(I) Emergency alerting and response procedures.

(J) Critique of response and follow-up.

(K) PPE and emergency equipment.

**(iii) Training.**

(A) Training for emergency response employees shall be completed before they are called upon to perform in real emergencies. Such training shall include the elements of the emergency response plan, standard operating procedures the employer has established for the job, the personal protective equipment to be worn and procedures for handling emergency incidents.

*Exception #1:* An employer need not train all employees to the degree specified if the employer divides the work force in a manner such that a sufficient number of employees who have responsibility to control emergencies have the training specified, and all other employees, who may first respond to an emergency incident, have sufficient awareness training to recognize that an emergency response situation exists and that they are instructed in that case to summon the fully trained employees and not attempt control activities for which they are not trained.

*Exception #2:* An employer need not train all employees to the degree specified if arrangements have been made in advance for an outside fully-trained emergency response team to respond in a reasonable period and all employees, who may come to the incident first, have sufficient awareness training to recognize that an emergency response situation exists and they have been instructed to call the designated outside fully-trained emergency response team for assistance.

(B) Employee members of TSD facility emergency response organizations shall be trained to a level of competence in the recognition of health and safety hazards to protect themselves and other employees. This would include training in the methods used to minimize the risk from safety and health hazards; in the safe use of control equipment; in

the selection and use of appropriate personal protective equipment; in the safe operating procedures to be used at the incident scene; in the techniques of coordination with other employees to minimize risks; in the appropriate response to over exposure from health hazards or injury to themselves and other employees; and in the recognition of subsequent symptoms which may result from over exposures.

(C) The employer shall certify that each covered employee has attended and successfully completed the training required in paragraph (p)(8)(iii) of this section, or shall certify the employee's competency at least yearly. The method used to demonstrate competency for certification of training shall be recorded and maintained by the employer.

(iv) Procedures for handling emergency incidents.

(A) In addition to the elements for the emergency response plan required in paragraph (p)(8)(ii) of this section, the following elements shall be included for emergency response plans to the extent that they do not repeat any information already contained in the emergency response plan:

(1) Site topography, layout, and prevailing weather conditions.

(2) Procedures for reporting incidents to local, state, and federal governmental agencies.

(B) The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.

(C) The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(D) The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(E) An employee alarm system shall be installed in accordance with 29 CFR 1910.165 to notify employees of an emergency situation; to stop work activities if necessary; to lower background noise in order to speed communication; and to begin emergency procedures.

(F) Based upon the information available at time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps.

#### **(q) Emergency response to hazardous substance releases.**

This paragraph covers employers whose employees are engaged in emergency response no matter where it occurs except that it does not cover employees engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section. Those emergency response organizations who have developed and implemented programs equivalent to this paragraph for handling releases of hazardous substances pursuant to section 303 of the Superfund Amendments and Reauthorization Act of 1986 (Emergency Planning and Community Right-to-Know Act of 1986, 42 U.S.C. 11003) shall be deemed to have met the requirements of this paragraph.

##### **(1) Emergency response plan.**

An emergency response plan shall be developed and implemented to handle anticipated emergencies prior to the commencement of emergency response operations. The plan shall be in writing and available for inspection and copying by employees, their representatives and OSHA personnel. Employers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan in accordance with §1910.38(a) of this part.

##### **(2) Elements of an emergency response plan.**

The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following to the extent that they are not addressed elsewhere:

(i) Pre-emergency planning and coordination with outside parties.

(ii) Personnel roles, lines of authority, training, and communication.

(iii) Emergency recognition and prevention.

(iv) Safe distances and places of refuge.

(v) Site security and control.

(vi) Evacuation routes and procedures.

(vii) Decontamination.

(viii) Emergency medical treatment and first aid.

(ix) Emergency alerting and response procedures.

(x) Critique of response and follow-up.

(xi) PPE and emergency equipment.

(xii) Emergency response organizations may use the local emergency response plan or the state emergency response plan or both, as part of their emergency response plan to avoid duplication. Those items of the emergency response plan that are being properly addressed by the SARA Title III plans may be substituted into their emergency plan or otherwise kept together for the employer and employee's use.

**(3) Procedures for handling emergency response.**

(i) The senior emergency response official responding to an emergency shall become the individual in charge of a site-specific Incident Command System (ICS). All emergency responders and their communications shall be coordinated and controlled through the individual in charge of the ICS assisted by the senior official present for each employer.

**Note to (q)(3)(i).** The "senior official" at an emergency response is the most senior official on the site who has the responsibility for controlling the operations at the site. Initially it is the senior officer on the first-due piece of responding emergency apparatus to arrive on the incident scene. As more senior officers arrive (i.e., battalion chief, fire chief, state law enforcement official, site coordinator, etc.) the position is passed up the line of authority which has been previously established.

(ii) The individual in charge of the ICS shall identify, to the extent possible, all hazardous substances or conditions present and shall address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance handling procedures, and use of any new technologies.

(iii) Based on the hazardous substances and/or conditions present, the individual in charge of the ICS shall implement appropriate emergency operations, and assure that the personal protective equipment worn is appropriate for the hazards to be encountered. However, personal protective equipment shall meet, at a minimum, the criteria contained in 29 CFR 1910.156(e) when worn while performing fire fighting operations beyond the incipient stage for any incident.

(iv) Employees engaged in emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard shall wear positive pressure

self-contained breathing apparatus while engaged in emergency response, until such time that the individual in charge of the ICS determines through the use of air monitoring that a decreased level of respiratory protection will not result in hazardous exposures to employees.

(v) The individual in charge of the ICS shall limit the number of emergency response personnel at the emergency site, in those areas of potential or actual exposure to incident or site hazards, to those who are actively performing emergency operations. However, operations in hazardous areas shall be performed using the buddy system in groups of two or more.

(vi) Back-up personnel shall stand by with equipment ready to provide assistance or rescue. Advance first aid support personnel, as a minimum, shall also stand by with medical equipment and transportation capability.

(vii) The individual in charge of the ICS shall designate a safety official, who is knowledgeable in the operations being implemented at the emergency response site, with specific responsibility to identify and evaluate hazards and to provide direction with respect to the safety of operations for the emergency at hand.

(viii) When activities are judged by the safety official to be an IDLH condition and/or to involve an imminent danger condition, the safety official shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the ICS of any actions needed to be taken to correct these hazards at the emergency scene.

(ix) After emergency operations have terminated, the individual in charge of the ICS shall implement appropriate decontamination procedures.

(x) When deemed necessary for meeting the tasks at hand, approved self-contained compressed air breathing apparatus may be used with approved cylinders from other approved self-contained compressed air breathing apparatus provided that such cylinders are of the same capacity and pressure rating. All compressed air cylinders used with self-contained breathing apparatus shall meet U.S. Department of Transportation and National Institute for Occupational Safety and Health criteria.

**(4) Skilled support personnel.**

Personnel, not necessarily an employer's own employees, who are skilled in the operation of certain equipment, such as mechanized earth moving or digging equipment or crane and hoisting equipment, and who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by an employer's own employees, and who will be or may be exposed to the hazards at an emergency response scene, are not required to meet the training required in this paragraph for the employer's regular employees. However, these personnel shall be given an initial briefing at the site prior to their participation in any emergency response. The initial briefing shall include instruction in the wearing of appropriate personal protective equipment, what chemical hazards are involved, and what duties are to be performed. All other appropriate safety and health precautions provided to the employer's own employees shall be used to assure the safety and health of these personnel.

**(5) Specialist employees.**

Employees who, in the course of their regular job duties, work with and are trained in the hazards of specific hazardous substances, and who will be called upon to provide technical advice or assistance at a hazardous substance release incident to the individual in charge, shall receive training or demonstrate competency in the area of their specialization annually.

**(6) Training.**

Training shall be based on the duties and function to be performed by each responder of an emergency response organization. The skill and knowledge levels required for all new responders, those hired after the effective date of this standard, shall be conveyed to them through training before they are permitted to take part in actual emergency operations on an incident. Employees who participate, or are expected to participate, in emergency response, shall be given training in accordance with the following paragraphs:

(i) First responder awareness level. First responders at the awareness level are individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond

notifying the authorities of the release. First responders at the awareness level shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:

(A) An understanding of what hazardous substances are, and the risks associated with them in an incident.

(B) An understanding of the potential outcomes associated with an emergency created when hazardous substances are present.

(C) The ability to recognize the presence of hazardous substances in an emergency.

(D) The ability to identify the hazardous substances, if possible.

(E) An understanding of the role of the first responder awareness individual in the employer's emergency response plan including site security and control and the U.S. Department of Transportation's Emergency Response Guidebook.

(F) The ability to realize the need for additional resources, and to make appropriate notifications to the communication center.

(ii) First responder operations level. First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keep it from spreading, and prevent exposures. First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:

(A) Knowledge of the basic hazard and risk assessment techniques.

(B) Know how to select and use proper personal protective equipment provided to the first responder operational level.

(C) An understanding of basic hazardous materials terms.

(D) Know how to perform basic control, containment and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit.

(E) Know how to implement basic decontamination procedures.

(F) An understanding of the relevant standard operating procedures and termination procedures.

**(iii) Hazardous materials technician.**

Hazardous materials technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder at the operations level in that they will approach the point of release in order to plug, patch or otherwise stop the release of a hazardous substance. Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(A) Know how to implement the employer's emergency response plan.

(B) Know the classification, identification and verification of known and unknown materials by using field survey instruments and equipment.

(C) Be able to function within an assigned role in the Incident Command System.

(D) Know how to select and use proper specialized chemical personal protective equipment provided to the hazardous materials technician.

(E) Understand hazard and risk assessment techniques.

(F) Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit.

(G) Understand and implement decontamination procedures.

(H) Understand termination procedures.

(I) Understand basic chemical and toxicological terminology and behavior.

**(iv) Hazardous materials specialist.**

Hazardous materials specialists are individuals who respond with and provide support to hazardous materials technician. Their duties parallel those of the hazardous materials technician, however, those duties require a more directed or specific knowledge of the various substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with Federal, state, local and other government authorities in regards to site activities. Hazardous materials specialists shall have received at least 24 hours of training equal

to the technician level and in addition have competency in the following areas and the employer shall so certify:

(A) Know how to implement the local emergency response plan.

(B) Understand classification, identification, and verification of known and unknown materials by using advanced survey instruments and equipment.

(C) Know of the state emergency response plan.

(D) Be able to select and use proper specialized chemical personal protective equipment provided to the hazardous materials specialist.

(E) Understand in-depth hazard and risk techniques.

(F) Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available.

(G) Be able to determine and implement decontamination procedures.

(H) Have the ability to develop a site safety and control plan.

(I) Understand chemical, radiological and toxicological terminology and behavior.

**(v) On scene incident commander.** Incident commanders, who will assume control of the incident scene beyond the first responder awareness level, shall receive at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(A) Know and be able to implement the employer's incident command system.

(B) Know how to implement the employer's emergency response plan.

(C) Know and understand the hazards and risks associated with employees working in chemical protective clothing.

(D) Know how to implement the local emergency response plan.

(E) Know of the state emergency response plan and the Federal Regional Response Team.

(F) Know and understand the importance of decontamination procedures.

**(7) Trainers.**

Trainers who teach any of the above training subjects shall have satisfactorily completed a training course for teaching the subjects they are expected to teach, such as the courses offered by the U.S. National Fire Academy, or they shall

have the training and/or academic credentials and instructional experience necessary to demonstrate competent instructional skills and a good command of the subject matter of the courses they are to teach.

**(8) Refresher training.**

(i) Those employees who are trained in accordance with paragraph (q)(6) of this section shall receive annual refresher training of sufficient content and duration to maintain their competencies, or shall demonstrate competency in those areas at least yearly.

(ii) A statement shall be made of the training or competency, and if a statement of competency is made, the employer shall keep a record of the methodology used to demonstrate competency.

**(9) Medical surveillance and consultation.**

(i) Members of an organized and designated HAZMAT team and hazardous materials specialists shall receive a baseline physical examination and be provided with medical surveillance as required in paragraph (f) of this section.

(ii) Any emergency response employees who exhibits signs or symptoms which may have resulted from exposure to hazardous substances during the course of an emergency incident, either immediately or subsequently, shall be provided with medical consultation as required in paragraph (f)(3)(ii) of this section.

**(10) Chemical protective clothing.**

Chemical protective clothing and equipment to be used by organized and designated HAZMAT team members, or to be used by hazardous materials specialists, shall meet the requirements of paragraphs (g)(3) through (5) of this section.

**(11) Post-emergency response operations.**

Upon completion of the emergency response, if it is determined that it is necessary to remove hazardous substances, health hazards, and materials contaminated with them (such as contaminated soil or other elements of the natural environment) from the site of the incident, the employer conducting the clean-up shall comply with one of the following:

(i) Meet all of the requirements of paragraphs (b) through (o) of this section; or

(ii) Where the clean-up is done on plant property using plant or workplace employees, such employees shall have completed the training

requirements of the following: 29 CFR 1910.38(a); 1910.134; 1910.1200, and other appropriate safety and health training made necessary by the tasks that they are expected to be performed such as personal protective equipment and decontamination procedures. All equipment to be used in the performance of the clean-up work shall be in serviceable condition and shall have been inspected prior to use.

**APPENDICES TO § 1910.120 - Hazardous Waste Operations & Emergency Response**

**NOTE:** The following appendices serve as nonmandatory guidelines to assist employees and employers in complying with the appropriate requirements of this section. However paragraph 1910.120(g) makes mandatory in certain circumstances the use of Level A and Level B PPE protection.

**APPENDIX A - Personal Protective Equipment Test Methods**

This appendix sets forth the non-mandatory examples of tests which may be used to evaluate compliance with § 1910.120 (g)(4)(ii) and (iii). Other tests and other challenge agents may be used to evaluate compliance.

**A. Totally-encapsulating chemical protective suit pressure test**

**1.0 - Scope**

**1.1** This practice measures the ability of a gas tight totally-encapsulating chemical protective suit material, seams, and closures to maintain a fixed positive pressure. The results of this practice allow the gas tight integrity of a total-encapsulating chemical protective suit to be evaluated.

**1.2** Resistance of the suit materials to permeation, penetration, and degradation by specific hazardous substances is not determined by this test method.

**2.0 - Definition of terms**

**2.1** "Totally-encapsulating chemical protective suit (TECP suit)" means a full body garment which is constructed of protective clothing materials; covers the wearer's torso, head, arms, legs, and respirator; may cover the wearer's hands and feet with tightly attached

gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer's gloves, and boots.

**2.2** "Protective clothing material" means any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

**2.3** "Gas tight" means, for the purpose of this test method, the limited flow of a gas under pressure from the inside of a TECP suit to atmosphere at a prescribed pressure and time interval.

### 3.0 - Summary of test method

**3.1** The TECP suit is visually inspected and modified for the test. The test apparatus is attached to the suit to permit inflation to the pre-test suit expansion pressure for removal of suit wrinkles and creases. The pressure is lowered to the test pressure and monitored for three minutes. If the pressure drop is excessive, the TECP suit fails the tests and is removed from service. The test is repeated after leak location and repair.

### 4.0 - Required Supplies

**4.1** Source of compressed air.

**4.2** Test apparatus for suit testing, including a pressure measurement device with a sensitivity of at least 1/4 inch water gauge.

**4.3** Vent valve closure plugs or sealing tape.

**4.4** Soapy water solution and soft brush.

**4.5** Stop watch or appropriate timing device.

### 5.0 - Safety Precautions

**5.1** Care shall be taken to provide the correct pressure safety devices required for the source of compressed air used.

### 6.0 - Test Procedure

**6.1** Prior to each test, the tester shall perform a visual inspection of the suit. Check the suit for seam integrity by visually examining the seams and gently pulling on the seams. Ensure that all air supply lines, fittings, visor, zippers, and valves are secure and show no signs of deterioration.

**6.1.1** Seal off the vent valves along with any other normal inlet or exhaust points (such as umbilical air line fittings or face piece opening) with tape or other appropriate means (caps, plugs, fixture, etc.). Care should be exercised in

the sealing process not to damage any of the suit components.

**6.1.2** Close all closure assemblies.

**6.1.3** Prepare the suit for inflation by providing an improvised connection point on the suit for connecting an airline. Attach the pressure test apparatus to the suit to permit suit inflation from a compressed air source equipped with a pressure indicating regulator. The leak tightness of the pressure test apparatus should be tested before and after each test by closing off the end of the tubing attached to the suit and assuring a pressure of three inches water gauge for three minutes can be maintained. If a component is removed for the test, that component shall be replaced and a second test conducted with another component removed to permit a complete tests of the ensemble.

**6.1.4** The pre-test expansion pressure (A) and the suite test pressure (B) shall be supplied by the suit manufacturer, but in no case shall they be less than: A=3 inches water gauge; and B=2 inches water gauge. The ending suit pressure (C) shall be no less than 80% of the test pressure (B); i.e., the pressure drop shall not exceed 20% of the test pressure (B).

**6.1.5** Inflate the suit until the pressure inside is equal to pressure (A), the pre-test expansion suit pressure. Allow at least one minute to fill out the wrinkles in the suit. Release sufficient air to reduce the suit pressure to pressure (B), the suit test pressure. Begin timing. At the end of three minutes, record the suit pressure as pressure (C), the ending suit pressure. The difference between the suit test pressure and the ending suit test pressure (B-C) shall be defined as the suit pressure drop.

**6.1.6** If the suit pressure drop is more than 20 percent of the suit test pressure (B) during the three-minute test period, the suit fails the test and shall be removed from service.

### 7.0 - Re-test Procedure

**7.1** If the suit fails the test check for leaks by inflating the suit to pressure (A) and brushing or wiping the entire suit (including seams, closures, lens gaskets, glove-to-sleeve joints, etc.) with a mild soap and water solution. Observe the suit for the formation of soap bubbles, which is an indication of a leak. Repair all identified leaks.

**7.2** Re-test the TECP suit as outlined in Test procedure 6.0.

## 8.0 - Report

**8.1** Each TECP suit tested by this practice shall have the following information recorded:

**8.1.1** Unique identification number, identifying brand name, date of purchase, material of construction, and unique fit features, e.g., special breathing apparatus.

**8.1.2** The actual values for test pressures (A), (B), and (C) shall be recorded along with the specific observation times. If the ending pressure (C) is less than 80% of the test pressure (B), the suit shall be identified as failing the test. When possible, the specific leak location shall be identified in the test records. Retest pressure data shall be recorded as an additional test.

**8.1.3** The source of the test apparatus used shall be identified and the sensitivity of the pressure gauge shall be recorded.

**8.1.4** Records shall be kept for each pressure test even if repairs are being made at the test location.

**Caution:** Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust valve to make sure it is not blocked. Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

## B. Totally-Encapsulating chemical protective suit qualitative leak test

### 1.0 - Scope

**1.1** This practice semi-qualitatively tests gas tight totally-encapsulating chemical protective suit integrity by detecting inward leakage of ammonia vapor. Since no modifications are made to the suit to carry out this test, the results from this practice provide a realistic test for the integrity of the entire suit.

**1.2** Resistance of the suit materials to permeation, penetration, and degradation is not determined by this test method. ASTM test methods are available to test suit materials for these characteristics and the tests are usually conducted by the manufacturers of the suits.

### 2.0 - Definition of terms

**2.1** "Totally-encapsulating chemical protective suit (TECP suit)" means a full body garment which is constructed of protective

clothing materials; covers the wearer's torso, head, arms, legs, and respirator; may cover the wearer's hands and feet with tightly attached gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer's gloves, and boots.

**2.2** "Protective clothing material" means any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

**2.3** "Gas tight" means, for the purpose of this test method, the limited flow of a gas under pressure from the inside of a TECP suit to atmosphere at a prescribed pressure and time interval.

**2.4** "Intrusion Coefficient" means a number expressing the level of protection provided by a gas tight totally-encapsulating chemical protective suit. The intrusion coefficient is calculated by dividing the test room challenge agent concentration by the concentration of challenge agent found inside the suit. The accuracy of the intrusion coefficient is dependent on the challenge agent monitoring methods. The larger the intrusion coefficient the greater the protection provided by the TECP suit.

## 3.0 - Summary of Recommended Practice

**3.1** The volume of concentrated aqueous ammonia solution (ammonia hydroxide,  $\text{NH}_4\text{OH}$ ) required to generate the test atmosphere is determined using the directions outlined in 6.1. The suit is donned by a person wearing the appropriate respiratory equipment (either a positive pressure self-contained breathing apparatus or a positive pressure supplied air respirator) and worn inside the enclosed test room. The concentrated aqueous ammonia solution is taken by the suited individual into the test room and poured into an open plastic pan. A two-minute evaporation period is observed before the test room concentration is measured, using a high range ammonia length of stain detector tube. When the ammonia vapor reaches a concentration of between 1000 and 1200 ppm, the suited individual starts a standardized exercise protocol to stress and flex the suit. After this protocol is completed the test room concentration is measured again. The suited individual exits the test room and his stand-by person measures the ammonia concentration inside the suit using a low range ammonia length of stain detector

tube or other more sensitive ammonia detector. A stand-by person is required to observe the test individual during the test procedure; aid the person in donning and doffing the TECP suit; and monitor the suit interior. The intrusion coefficient of the suit can be calculated by dividing the average test area concentration by the interior suit concentration. A colorimetric indicator strip of bromophenol blue or equivalent is placed on the inside of the suit face piece lens so that the suited individual is able to detect a color change and know if the suit has a significant leak. If a color change is observed the individual shall leave the test room immediately.

#### 4.0 - Required Supplies

**4.1** A supply of concentrated aqueous ammonium hydroxide (58% by weight).

**4.2** A supply of bromophenol/blue indicating paper or equivalent, sensitive to 5-10 ppm ammonia or greater over a two-minute period of exposure. [pH 3.0 (yellow) to pH 4.6 (blue)].

**4.3** A supply of high range (0.5-10 volume percent) and low range (5-700 ppm) detector tubes for ammonia and the corresponding sampling pump. More sensitive ammonia detectors can be substituted for the low range detector tubes to improve the sensitivity of this practice.

**4.4** A shallow plastic pan (PVC) at least 12":14":1" and a half pint plastic container (PVC) with tightly closing lid.

**4.5** A graduated cylinder or other volumetric measuring device of at least 50 milliliters in volume with an accuracy of at least +/- 1 milliliters.

#### 5.0 - Safety Precautions

**5.1** Concentrated aqueous ammonium hydroxide,  $\text{NH}_4 \text{OH}$ , is a corrosive volatile liquid requiring eye, skin, and respiratory protection. The person conducting the test shall review the MSDS for aqueous ammonia.

**5.2** Since the established permissible exposure limit for ammonia is 35 ppm as a 15 minute STEL, only persons wearing a positive pressure self-contained breathing apparatus or a positive pressure supplied air respirator shall be in the chamber. Normally only the person wearing the totally-encapsulating suit will be inside the chamber. A stand-by person shall have a positive pressure self-contained breathing apparatus, or a positive pressure supplied air

respirator available to enter the test area should the suited individual need assistance.

**5.3** A method to monitor the suited individual must be used during this test. Visual contact is the simplest but other methods using communication devices are acceptable.

**5.4** The test room shall be large enough to allow the exercise protocol to be carried out and then to be ventilated to allow for easy exhaust of the ammonia test atmosphere after the test(s) are completed.

**5.5** Individuals shall be medically screened for the use of respiratory protection and checked for allergies to ammonia before participating in this test procedure.

#### 6.0 - Test Procedure

**6.1.1** Measure the test area to the nearest foot and calculate its volume in cubic feet. Multiply the test area volume by 0.2 milliliters of concentrated aqueous ammonia per cubic foot of test area volume to determine the approximate volume of concentrated aqueous ammonia required to generate 1000 ppm in the test area.

**6.1.2** Measure this volume from the supply of concentrated aqueous ammonia and place it into a closed plastic container.

**6.1.3** Place the container, several high range ammonia detector tubes, and the pump in the clean test pan and locate it near the test area entry door so that the suited individual has easy access to these supplies.

**6.2.1** In a non-contaminated atmosphere, open a pre-sealed ammonia indicator strip and fasten one end of the strip to the inside of the suit face shield lens where it can be seen by the wearer. Moisten the indicator strip with distilled water. Care shall be taken not to contaminate the detector part of the indicator paper by touching it. A small piece of masking tape or equivalent should be used to attach the indicator strip to the interior of the suit face shield.

**6.2.2** If problems are encountered with this method of attachment, the indicator strip can be attached to the outside of the respirator face piece lens being used during the test.

**6.3** Don the respiratory protective device normally used with the suit; and then don the TECP suit to be tested. Check to be sure all openings which are intended to be sealed (zippers, gloves, etc.) are completely sealed. DO NOT, however, plug off any venting valves.

**6.4** Step into the enclosed test room such as a closet, bathroom, or test booth, equipped with an exhaust fan. No air should be exhausted from the chamber during the test because this will dilute the ammonia challenge concentrations.

**6.5** Open the container with the pre-measured volume of concentrated aqueous ammonia within the enclosed test room, and pour the liquid into the empty plastic test pan. Wait two minutes to allow for adequate volatilization of the concentrated aqueous ammonia. A small mixing fan can be used near the evaporation pan to increase the evaporation rate of the ammonia solution.

**6.6** After two minutes a determination of the ammonia concentration within the chamber should be made using the high range colorimetric detector tube. A concentration of 1000 ppm ammonia or greater shall be generated before the exercises are started.

**6.7** To test the integrity of the suit the following four minute exercise protocol should be followed:

**6.7.1** Raising the arms above the head with at least 15 raising motions completed in one minute.

**6.7.2** Walking in place for one minute with at least 15 raising motions of each leg in a one-minute period.

**6.7.3** Touching the toes with a least 10 complete motions of the arms from above the head to touching of the toes in a one-minute period.

**6.7.4** Knee bends with at least 10 complete standing and squatting motions in a one-minute period.

**6.8** If at any time during the test the colorimetric indicating paper should change colors, the test should be stopped and section 6.10 and 6.12 initiated (see ¶4.2).

**6.9** After completion of the test exercise, the test area concentration should be measured again using the high range colorimetric detector tube.

**6.10** Exit the test area.

**6.11** The opening created by the suit zipper or other appropriate suit penetration should be used to determine the ammonia concentration in the suit with the low range length of stain detector tube or other ammonia monitor. The internal TECP suit air should be sampled far enough from the enclosed test area to prevent a false ammonia reading.

**6.12** After completion of the measurement of the suit interior ammonia concentration the test is concluded and the suit is doffed and the respirator removed.

**6.13** The ventilating fan for the test room should be turned on and allowed to run for enough time to remove the ammonia gas. The fan shall be vented to the outside of the building.

**6.14** Any detectable ammonia in the suit interior [5 ppm (NH<sub>3</sub>) or more for the length of stain detector tube] indicates that the suit has failed the test. When other ammonia detectors are used a lower level of detection is possible, and it should be specified as the pass fail criteria.

**6.15** By following this test method, an intrusion coefficient of approximately 200 or more can be measured with the suit in a completely operational condition. If the intrusion coefficient is 200 or more, then the suit is suitable for emergency response and field use.

## **7.0 - Re-test Procedures**

**7.1** If the suit fails this test, check for leaks by following the pressure test in test A above.

**7.2** Re-test the TECP suit as outlined in the test procedure 6.0.

## **8.0 - Report**

**8.1** Each gas tight totally-encapsulating chemical protective suit tested by this practice shall have the following information recorded.

**8.1.1** Unique identification number, identifying brand name, date of purchase, material of construction, and unique suit features; e.g., special breathing apparatus.

**8.1.2** General description of test room used for test.

**8.1.3** Brand name and purchase date of ammonia detector strips and color change data.

**8.1.4** Brand name, sampling range, and expiration date of the length of stain ammonia detector tubes. The brand name and model of the sampling pump should also be recorded. If another type of ammonia detector is used, it should be identified along with its minimum detection limit for ammonia.

**8.1.5** Actual test results shall list the two test area concentrations, their average, the interior suit concentration, and the calculated intrusion coefficient. Re-test data shall be recorded as an additional test.

**8.2** The evaluation of the data shall be specified as "suit passed" or "suit failed", and the

date of the test. Any detectable ammonia (five ppm or greater for the length of stain detector tube) in the suit interior indicates the suit fails this test. When other ammonia detectors are used, a lower level of detection is possible and it should be specified as the pass fail criteria.

**Caution:** Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust valve to make sure it is not blocked. Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

### **APPENDIX B - General Description and Discussion of the Levels of Protection and Protective Gear**

This appendix sets forth information about personal protective equipment (PPE) protection levels which may be used to assist employers in complying with the PPE requirements of this section.

As required by the standard, PPE must be selected which will protect employees from the specific hazards which they are likely to encounter during their work on-site.

Selection of the appropriate PPE is a complex process which must take into consideration a variety of factors. Key factors involved in this process are identification of the hazards, or suspected hazards; their routes of potential hazard to employees (inhalation, skin absorption, ingestion, and eye or skin contact); and the performance of the PPE materials (and seams) in providing a barrier to these hazards. The amount of protection provided by PPE is material-hazard specific. That is, protective equipment materials will protect well against some hazardous substances and poorly, or not at all, against others. In many instances, protective equipment materials cannot be found which will provide continuous protection from the particular hazardous substance. In these cases the breakthrough time of the protective material should exceed the work durations.

Other factors in this selection process to be considered are matching the PPE to the employee's work requirements and task-specific conditions. The durability of PPE materials, such as tear strength and seam strength, should be considered in relation to the employee's tasks.

The effects of PPE in relation to heat stress and task duration are a factor in selecting and using PPE. In some cases layers of PPE may be necessary to provide sufficient protection, or to protect expensive PPE inner garments, suits or equipment.

The more that is known about the hazards at the site, the easier the job of PPE selection becomes. As more information about the hazards and conditions at the site becomes available, the site supervisor can make decisions to up-grade or down-grade the level of PPE protection to match the tasks at hand.

The following are guidelines which an employer can use to begin the selection of the appropriate PPE. As noted above, the site information may suggest the use of combinations of PPE selected from the different protection levels (i.e., A, B, C, or D) as being more suitable to the hazards of the work. It should be cautioned that the listing below does not fully address the performance of the specific PPE material in relation to the specific hazards at the job site, and that PPE selection, evaluation and re-selection is an ongoing process until sufficient information about the hazards and PPE performance is obtained.

#### **Part A.**

Personal protective equipment is divided into four categories based on the degree of protection afforded. (See Part B of this appendix for further explanation of Levels A, B, C, and D hazards.)

**I. Level A** - To be selected when the greatest level of skin, respiratory, and eye protection is required. The following constitute Level A equipment; it may be used as appropriate;

1. Positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH).
2. Totally-encapsulating chemical-protective suit.
3. Coveralls.\*
4. Long underwear.\*
5. Gloves, outer, chemical-resistant.
6. Gloves, inner, chemical-resistant.
7. Boots, chemical-resistant, steel toe and shank.

8. Hard hat (under suit).\*
9. Disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit).

\* Optional, as applicable.

**II. Level B** - The highest level of respiratory protection is necessary but a lesser level of skin protection is needed. The following constitute Level B equipment; it may be used as appropriate.

1. Positive pressure, full-face piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved).
2. Hooded chemical-resistant clothing (coveralls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant coveralls).
3. Coveralls.\*
4. Gloves, outer, chemical-resistant.
5. Gloves, inner, chemical-resistant.
6. Boots, outer, chemical-resistant steel toe and shank.
7. Boot-covers, outer, chemical-resistant (disposable).\*
8. Hard hat.
9. [Reserved]
10. Face shield.\*

\* Optional, as applicable.

**III. Level C** - The concentration(s) and type(s) of airborne substance(s) is known and the criteria for using air purifying respirators are met. The following constitute Level C equipment; it may be used as appropriate.

1. Full-face or half-mask, air purifying respirators (NIOSH approved).
2. Hooded chemical-resistant clothing (coveralls; two-piece chemical-splash suit; disposable chemical-resistant coveralls).
3. Coveralls.\*
4. Gloves, outer, chemical-resistant.
5. Gloves, inner, chemical-resistant.
6. Boots (outer), chemical-resistant steel toe and shank.\*
7. Boot-covers, outer, chemical-resistant (disposable).\*
8. Hard hat.\*
9. Escape mask.\*
10. Face shield.\*

\* Optional, as applicable.

**IV. Level D** - A work uniform affording minimal protection, used for nuisance contamination only. The following constitute Level D equipment; it may be used as appropriate.

1. Coveralls.
2. Gloves.\*
3. Boots/shoes, chemical-resistant steel toe and shank.
4. Boots, outer, chemical-resistant (disposable).\*
5. Safety glasses or chemical splash goggles.\*
6. Hard hat.\*
7. Escape mask.\*
8. Face shield.\*

\* Optional, as applicable.

## Part B.

The types of hazards for which levels A, B, C, and D protection are appropriate are described below:

**I. Level A** - Level A protection should be used when:

1. The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either the measured (or potential for) high concentration of atmospheric vapors, gases, or particulates; or the site operations and work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the intact skin;
2. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible; or
3. Operations must be conducted in confined, poorly ventilated areas, and the absence of conditions requiring Level A have not yet been determined.

**II. Level B** - Level B protection should be used when:

1. The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection;
2. The atmosphere contains less than 19.5 percent oxygen; or

3. The presence of incompletely identified vapors or gases is indicated by a direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the skin.

**Note:** This involves atmospheres with IDLH concentrations of specific substances that present severe inhalation hazards and that do not represent severe skin hazard; or that do not meet the criteria for use of air-purifying respirators.

**III. Level C** - Level C protection should be used when:

1. The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin;
2. The types of air contaminants have been identified, concentrations measured, and an air-purifying respirator is available that can remove the contaminants; and
3. All criteria for the use of air-purifying respirators are met.

**IV. Level D** - Level D protection should be used when:

1. The atmosphere contains no known hazard; and
2. Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

**Note:** As stated before, combinations of personal protective equipment other than those described for Levels A, B, C, and D protection may be more appropriate and may be used to provide the proper level of protection.

As an aid in selecting suitable chemical protective clothing, it should be noted that the National Fire Protection Association is developing standards on chemical protective clothing. These standards are currently undergoing public review prior to adoption, including:

NFPA 1991 - Standard on Vapor-Protective Suits for Hazardous Chemical Emergencies (EPA Level A Protective Clothing)

NFPA 1992 - Standard on Liquid Splash-Protective Suits for Hazardous Chemical Emergencies (EPA Level B Protective Clothing)

NFPA 1993 - Standard on Liquid Splash-Protective Suits for Non-emergency, Non-flammable Hazardous Chemical Situations (EPA Level B Protective Clothing)

These standards would apply documentation and performance requirements to the manufacturer of chemical protective suits. Chemical protective suits meeting these requirements would be labelled as compliant with the appropriate standard. When these standards are adopted by the National Fire Protection Association, it is recommended that chemical protective suits which meet these standards be used.

## APPENDIX C - Compliance Guidelines

### 1. Occupational Safety and Health Program.

Each hazardous waste site clean-up effort will require a site specific occupational safety and health program headed by the site coordinator or the employer's representative. The purpose of the program will be the protection of employees at the site and will be an extension of the employer's overall safety and health program. The program will need to be developed before work begins on the site and implemented as work proceeds as stated in paragraph (b). The program is to facilitate coordination and communication of safety and health issues among personnel responsible for the various activities which will take place at the site. It will provide the overall means for planning and implementing the needed safety and health training and job orientation of employees who will be working at the site. The program will provide the means for identifying and controlling work site hazards and the means for monitoring program effectiveness. The program will need to cover the responsibilities and authority of the site coordinator or the employer's manager on the site for the safety and health of employees at the site, and the relationships with contractors or support services as to what each employer's safety and health responsibilities are for their employees on the site. Each contractor on the site needs to have its own safety and health program so structured that it will smoothly interface with

the program of the site coordinator or principal contractor.

Also those employers involved with treating, storing, or disposal of hazardous waste as covered in paragraph (p) must have implemented a safety and health program for their employees. This program is to include the hazard communication program required in paragraph (p)(1) and the training required in paragraphs (p)(7) and (p)(8) as parts of the employers comprehensive overall safety and health program. This program is to be in writing.

Each site or workplace safety and health program will need to include the following: (1) Policy statements of the line of authority and accountability for implementing the program, the objectives of the program and the role of the site safety and health supervisor or manager and staff; (2) means or methods for the development of procedures for identifying and controlling work place hazards at the site; (3) means or methods for the development and communication to employees of the various plans, work rules, standard operating procedures and practices that pertain to individual employees and supervisors; (4) means for the training of supervisors and employees to develop the needed skills and knowledge to perform their work in a safe and healthful manner; (5) means to anticipate and prepare for emergency situations; and (6) means for obtaining information feedback to aid in evaluating the program and for improving the effectiveness of the program. The management and employees should be trying continually to improve the effectiveness of the program thereby enhancing the protection being afforded those working on the site.

Accidents on the site or workplace should be investigated to provide information on how such occurrences can be avoided in the future. When injuries or illness occur on the site or workplace, they will need to be investigated to determine what needs to be done to prevent this incident from occurring again. Such information will need to be used as feedback on the effectiveness of the program and the information turned into positive steps to prevent any reoccurrence. Receipt of employee suggestions or complaints relating to safety and health issues involved with site or workplace activities is also a feedback mechanism that can be used effectively to improve the program and may serve in part as an evaluative tool(s).

For the development and implementation of the program to be the most effective, professional safety and health personnel should be used. Certified Safety Professionals, Board Certified Industrial Hygienists or Registered Professional Safety Engineers are good examples of professional stature for safety and health managers who will administer the employer's program.

## **2. Training.**

The training programs for employees subject to the requirements of paragraph (e) of this standard should address: the safety and health hazards employees should expect to find on hazardous waste clean-up sites; what control measures or techniques are effective for those hazards; what monitoring procedures are effective in characterizing exposure levels; what makes an effective employer's safety and health program; what a site safety and health plan should include; hands on training with personal protective equipment and clothing they may be expected to use; the contents of the OSHA standard relevant to the employee's duties and function; and, employee's responsibilities under OSHA and other regulations. Supervisors will need training in their responsibilities under the safety and health program and its subject areas such as the spill containment program, the personal protective equipment program, the medical surveillance program, the emergency response plan and other areas.

The training programs for employees subject to the requirements of paragraph (p) of this standard should address: the employer's safety and health program elements impacting employees; the hazard communication program; the medical surveillance program; the hazards and the controls for such hazards that employees need to know for their job duties and functions. All require annual refresher training.

The training programs for employees covered by the requirements of paragraph (q) of this standard should address those competencies required for the various levels of response such as: the hazards associated with hazardous substances; hazard identification and awareness; notification of appropriate persons; the need for and use of personal protective equipment including respirators; the decontamination procedures to be used; preplanning activities for hazardous substance incidents including the

emergency response plan; company standard operating procedures for hazardous substance emergency responses; the use of the incident command system and other subjects. Hands-on training should be stressed whenever possible. Critiques done after an incident which include an evaluation of what worked and what did not and how could the incident be better handled the next time may be counted as training time.

For hazardous materials specialists (usually members of hazardous materials teams), the training should address the care, use and/or testing of chemical protective clothing including totally-encapsulation suits, the medical surveillance program, the standard operation procedures for the hazardous materials team including the use of plugging and patching equipment and other subject areas.

Officers and leaders who may be expected to be in charge at an incident should be fully knowledgeable of their company's incident command system. They should know where and how to obtain additional assistance and be familiar with the local district's emergency response plan and the state emergency response plan.

Specialist employees such as technical experts, medical experts or environmental experts that work with hazardous materials in their regular jobs, who may be sent to the incident scene by the shipper, manufacturer or governmental agency to advise and assist the person in charge of the incident should have training on an annual basis. Their training should include the care and use of personal protective equipment including respirators; knowledge of the incident command system and how they are to relate to it; and those areas needed to keep them current in their respective field as it relates to safety and health involving specific hazardous substances.

Those skilled support personnel, such as employees who work for public works departments or equipment operators who operate bulldozers, sand trucks, backhoes, etc., who may be called to the incident scene to provide emergency support assistance, should have at least a safety and health briefing before entering the area of potential or actual exposure. These skilled support personnel, who have not been a part of the emergency response plan and do not meet the training requirements, should be made aware of the hazards they face and should be

provided all necessary protective clothing and equipment required for their tasks.

There are two National Fire Protection Association standards, NFPA 472 - "Standard for Professional Competence of Responders to Hazardous Material Incidents", which are excellent resource documents to aid fire departments and other emergency response organizations in developing their training program materials. NFPA 472 provides guidance on the skills and knowledge needed for first responder awareness level, first responder operations level, hazmat technicians, and hazmat specialist. It also offers guidance for the officer corp who will be in charge of hazardous substance incidents.

### **3. Decontamination.**

Decontamination procedures should be tailored to the specific hazards of the site and may vary in complexity and number of steps, depending on the level of hazard and the employee's exposure to the hazard. Decontamination procedures and PPE decontamination methods will vary depending upon the specific substance, since one procedure or method may not work for all substances. Evaluation of decontamination methods and procedures should be performed, as necessary, to assure that employees are not exposed to hazards by reusing PPE. References in Appendix D may be used for guidance in establishing an effective decontamination program. In addition, the U.S. Coast Guard's Manual, "Policy Guidance for Response to Hazardous Chemical Releases," U.S. Department of Transportation, Washington, DC (COMDTINST M16465.30) is a good reference for establishing an effective decontamination program.

### **4. Emergency response plans.**

States, along with designated districts within the states, will be developing or have developed local emergency response plans. These state and district plans should be utilized in the emergency response plans called for in this standard. Each employer should assure that its emergency response plan is compatible with the local plan. The major reference being used to aid in developing the state and local district plans is the Hazardous Materials Emergency Planning Guide, NRT-1. The current Emergency Response Guidebook from the U.S. Department of

Transportation, CMA's CHEMTREC and the Fire Service Emergency Management Handbook may also be used as resources.

Employers involved with treatment, storage, and disposal facilities for hazardous waste, which have the required contingency plan called for by their permit, would not need to duplicate the same planning elements. Those items of the emergency response plan that are properly addressed in the contingency plan may be substituted into the emergency response plan required in 1910.120 or otherwise kept together for employer and employee use.

### **5. Personal protective equipment programs.**

The purpose of personal protective clothing and equipment (PPE) is to shield or isolate individuals from the chemical, physical, and biological hazards that may be encountered at a hazardous substance site.

As discussed in Appendix B, no single combination of protective equipment and clothing is capable of protecting against all hazards. Thus PPE should be used in conjunction with other protective methods and its effectiveness evaluated periodically.

The use of PPE can itself create significant worker hazards, such as heat stress, physical and psychological stress, and impaired vision, mobility, and communication. For any given situation, equipment and clothing should be selected that provide an adequate level of protection. However, over-protection, as well as under-protection, can be hazardous and should be avoided where possible.

Two basic objectives of any PPE program should be to protect the wearer from safety and health hazards, and to prevent injury to the wearer from incorrect use and/or malfunction of the PPE. To accomplish these goals, a comprehensive PPE program should include hazard identification, medical monitoring, environmental surveillance, selection, use, maintenance, and decontamination of PPE and its associated training.

The written PPE program should include policy statements, procedures, and guidelines. Copies should be made available to all employees, and a reference copy should be made available at the work site. Technical data on equipment, maintenance manuals, relevant regulations, and

other essential information should also be collected and maintained.

### **6. Incident command system (ICS).**

Paragraph 1910.120(q)(3)(ii) requires the implementation of an ICS. The ICS is an organized approach to effectively control and manage operations at an emergency incident. The individual in charge of the ICS is the senior official responding to the incident. The ICS is not much different than the "command post" approach used for many years by the fire service. During large complex fires involving several companies and many pieces of apparatus, a command post would be established. This enabled one individual to be in charge of managing the incident, rather than having several officers from different companies making separate, and sometimes conflicting, decisions. The individual in charge of the command post would delegate responsibility for performing various tasks to subordinate officers. Additionally, all communications were routed through the command post to reduce the number of radio transmissions and eliminate confusion. However, strategy, tactics, and all decisions were made by one individual.

The ICS is a very similar system, except it is implemented for emergency response to all incidents, both large and small, that involve hazardous substances.

For a small incident, the individual in charge of the ICS may perform many tasks of the ICS. There may not be any, or little, delegation of tasks to subordinates. For example, in response to a small incident, the individual in charge of the ICS, in addition to normal command activities, may become the safety officer and may designate only one employee (with proper equipment) as a backup to provide assistance if needed. OSHA does recommend, however, that at least two employees be designated as back-up personnel since the assistance needed may include rescue.

To illustrate the operations of the ICS, the following scenario might develop during a small incident, such as an overturned tank truck with a small leak of flammable liquid.

The first responding senior officer would implement and take command of the ICS. That person would size-up the incident and determine if additional personnel and apparatus were necessary; would determine what actions to take

to control the leak; and , determine the proper level of personal protective equipment. If additional assistance is not needed, the individual in charge of the ICS would implement actions to stop and control the leak using the fewest number of personnel that can effectively accomplish the tasks. The individual in charge of the ICS then would designate himself as the safety officer and two other employees as a back-up in case rescue may become necessary. In this scenario, decontamination procedures would not be necessary.

A large complex incident may require many employees and difficult, time-consuming efforts to control. In these situations, the individual in charge of the ICS will want to delegate different tasks to subordinates in order to maintain a span of control that will keep the number of subordinates, that are reporting, to a manageable level.

Delegation of tasks at large incidents may be by location, where the incident scene is divided into sectors, and subordinate officers coordinate activities within the sector that they have been assigned.

Delegation of tasks can also be by function. Some of the functions that the individual in charge of the ICS may want to delegate at a large incident are: medical services; evacuation; water supply; resources (equipment, apparatus); media relations; safety; and, site control (integrate activities with police for crowd and traffic control). Also for a large incident, the individual in charge of the ICS will designate several employees as back-up personnel; and a number of safety officers to monitor conditions and recommend safety precautions.

Therefore, no matter what size or complexity an incident may be, by implementing an ICS there will be one individual in charge who makes the decisions and gives directions; and , all actions, and communications are coordinated through one central point of command. Such a system should reduce confusion, improve safety, organize and coordinate actions, and should facilitate effective management of the incident.

### **7. Site Safety and Control Plans.**

The safety and security of response personnel and others in the area of an emergency response incident site should be of primary concern to the incident commander. The use of a site safety and control plan could greatly assist

those in charge of assuring the safety and health of employees on the site.

A comprehensive site safety and control plan should include the following; summary analysis of hazards on the site and a risk analysis of those hazards; site map or sketch; site work zones (clean zone, transition or decontamination zone, work or hot zone); use of the buddy system; site communications; command post or command center; standard operating procedures and safe work practices; medical assistance and triage area; hazard monitoring plan (air contaminate monitoring, etc.); decontamination procedures and area; and other relevant areas. This plan should be a part of the employer's emergency response plan or an extension of it to the specific site.

### **8. Medical surveillance programs.**

Workers handling hazardous substances may be exposed to toxic chemicals, safety hazards, biologic hazards, and radiation. Therefore, a medical surveillance program is essential to assess and monitor workers' health and fitness for employment in hazardous waste operations and during the course of work; to provide emergency and other treatment as needed; and to keep accurate records for future reference.

*The Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* developed by the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), the U.S. Coast Guard (USCG), and the Environmental Protection Agency (EPA); October 1985 provides an excellent example of the types of medical testing that should be done as part of a medical surveillance program.

### **9. New Technology and Spill Containment Programs.**

Where hazardous substances may be released by spilling from a container that will expose employees to the hazards of the materials, the employer will need to implement a program to contain and control the spilled material. Diking and ditching, as well as use of absorbents like diatomaceous earth, are traditional techniques which have proven to be effective over the years. However, in recent years new products have come into the marketplace, the use of which complement and increase the effectiveness of these traditional methods. These new products

also provide emergency responders and other with additional tools or agents to use to reduce the hazards of spilled materials.

These agents can be rapidly applied over a large area and can be uniformly applied or otherwise can be used to build a small dam, thus improving the workers' ability to control spilled material. These application techniques enhance the intimate contact between the agent and the spilled material allowing for the quickest effect by the agent or quickest control of the spilled material. Agents are available to solidify liquid spilled materials, to suppress vapor generation from spilled materials, and to do both. Some special agents, which when applied as recommended by the manufacturer, will react in a controlled manner with the spilled materials to neutralize acids or caustics, or greatly reduce the level of hazard of the spilled material.

There are several modern methods and devices for use by emergency response personnel or others involved with spill control efforts to safely apply spill control agents to control spilled material hazards. These include portable pressurized applicators similar to hand-held portable fire extinguishing devices, and nozzle and hose systems similar to portable fire fighting foam systems which allow the operator to apply the agent to the spilled material for a remote position.

The solidification of liquid provides for rapid containment and isolation of hazardous substance spills. By directing the agent at run-off points or at the edges of the spill, the reactant solid will automatically create a barrier to slow or stop the spread of the material. Clean-up of hazardous substance is greatly improved when solidifying agents, acid or caustic neutralizers, or activated carbon adsorbents are used. Properly applied, these agents can totally solidify liquid hazardous substances or neutralize or absorb them, which results in materials which are less hazardous and easier to handle, transport, and dispose of. The concept of spill treatment, to create less hazardous substances, will improve the safety and level of clean-up operations to spills of hazardous substances.

The use of vapor suppression agents for volatile hazardous substances, such as flammable liquids and those substances which present an inhalation hazard, is important for protecting workers. The rapid and uniform distribution of the agent over the surface of the spilled material

can provide quick vapor knockdown. There are temporary and long-term foam-type agents which are effective on vapors and dusts, and activated carbon adsorption agents which are effective for vapor control and soaking-up of the liquid. The proper use of hose lines or hand-held portable pressurized applicators provides good mobility and permits the worker to deliver the agent from a safe distance without having to step into the untreated spilled material. Some of these systems can be recharged in the field to provide coverage of larger spill areas than the design limits of a single charged applicator unit. Some of the more effective agents can solidify the liquid flammable hazardous substances and at the same time elevate the flashpoint above 140°F so the resulting substance may be handled as a nonhazardous waste material if it meets the U.S. Environmental Protection Agency's 40 CFR Part 261 requirements (see particularly § 261.21).

All workers performing hazardous substance spill control work are expected to wear the proper protective clothing and equipment for the materials present and to follow the employer's established standard operating procedures for spill control. All involved workers need to be trained in the established operating procedures; in the use and care of spill control equipment; and in the associated hazards and control of such hazards of spill containment work.

These new tools and agents are the things that employers will want to evaluate as part of their new technology program. The treatment of spills of hazardous substances or wastes at an emergency incident as part of the immediate spill containment and control efforts is sometimes acceptable to EPA and a permit exception is described in 40 CFR 264.1(g)(8) and 265.1(s)(11).

## APPENDIX D - References

The following references may be consulted for further information on the subject of this standard:

1. OSHA Instruction DFO CPL 2.70 - January 29, 1986, *Special Emphasis Program: Hazardous Waste Sites*.
2. OSHA Instruction DFO CPL 2-2.37A - January 29, 1986, *Technical Assistance and Guidelines for Superfund and Other Hazardous Waste Site Activities*.

3. OSHA Instruction DTS CPL 2.74 - January 29, 1986, *Hazardous Waste Activity Form*, OSHA 175.
  4. *Hazardous Waste Inspections Reference Manual*, U. S. Department of Labor, Occupational Safety and Health Administration, 1986.
  5. Memorandum of Understanding Among the National Institute for Occupational Safety and Health, the Occupational Safety and Health Administration, the United States Coast Guard, and the United States Environmental Protection Agency, *Guidance for Worker Protection During Hazardous Waste Site Investigations and Clean-up and Hazardous Substance Emergencies*. December 18, 1980.
  6. *National Priorities List*, 1st Edition, October 1984; U. S. Environmental Protection Agency, Revised periodically.
  7. *The Decontamination of Response Personnel*, Field Standard Operating Procedures (F.S.O.P.) 7; U. S. Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Response Support Division, December 1984.
  8. *Preparation of a Site Safety Plan*, Field Standard Operating Procedures (F.S.O.P.) 9; U. S. Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Response Support Division, April 1985.
  9. *Standard Operating Safety Guidelines*; U. S. Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Response Support Division, Environmental Response Team; November 1984.
  10. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U. S. Coast Guard (USCG), and Environmental Protection Agency (EPA); October 1985.
  11. *Protecting Health and Safety at Hazardous Waste Sites: An Overview*, U. S. Environmental Protection Agency, EPA/625/9-85/006; September 1985.
  12. *Hazardous Waste Sites and Hazardous Substance Emergencies*, NIOSH Worker Bulletin, U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health; December 1982.
  13. *Personal Protective Equipment for Hazardous Materials Incidents: A Selection Guide*; U. S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health; October 1984.
  14. *Fire Service Emergency Management Handbook*, International Association of Fire Chiefs Foundation, 101 East Holly Avenue, Unit 10B, Sterling, VA 22170, January 1985.
  15. *Emergency Response Guidebook*, U. S. Department of Transportation, Washington, DC, 1983.
  16. *Report to the Congress on Hazardous Materials Training, Planning and Preparedness*, Federal Emergency Management Agency, Washington, DC, July 1986.
  17. *Workbook for Fire Command*, Alan V. Brunacini and J. David Beageron, National Fire Protection Association, Batterymarch Park, Quincy, MA 02269, 1985.
  18. *Fire Command*, Alan V. Brunacini, National Fire Prevention Association, Batterymarch Park, Quincy, MA 02269, 1985.
  19. *Incident Command System*, Fire Protection Publications, Oklahoma State University, Stillwater, OK 74078, 1983.
  20. *Site Emergency Response Planning*, Chemical Manufacturers Association, Washington, DC 20037, 1986.
  21. *Hazardous Materials Emergency Planning Guide*, NRT-1, Environmental Protection Agency, Washington, DC, March 1987.
  22. *Community Teamwork: Working Together to Promote Hazardous Materials Transportation Safety*, U.S. Department of Transportation, Washington, DC, May 1983.
  23. *Disaster Planning Guide for Business and Industry*, Federal Emergency Management Agency, Publication No. FEMA141, August 1987.
- (The Office of Management and Budget has approved the information collection requirements in this section under control number 1218-0139)

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**SUBPART I  
PERSONAL PROTECTIVE EQUIPMENT****29 CFR 1910.132 General requirements****(a) Application.**

Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

**(b) Employee-owned equipment.**

Where employees provide their own protective equipment, the employer shall be responsible to assure its adequacy, including proper maintenance, and sanitation of such equipment.

**(c) Design.**

All personal protective equipment shall be of safe design and construction for the work to be performed.



**SUBPART I  
PERSONAL PROTECTIVE EQUIPMENT****29 CFR 1910.134 Respiratory Protection.**

This section applies to General Industry (part 1910), Shipyards (part 1915), Marine Terminals (part 1917), Longshoring (part 1918), and Construction (part 1926).

**(a) Permissible practice.**

(1) In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to this section.

(2) Respirators shall be provided by the employer when such equipment is necessary to protect the health of the employee. The employer shall provide the respirators which are applicable and suitable for the purpose intended. The employer shall be responsible for the establishment and maintenance of a respiratory protection program which shall include the requirements outlined in paragraph (c) of this section.

**(b) Definitions.**

The following definitions are important terms used in the respiratory protection standard in this section.

**Air-purifying respirator** means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

**Assigned protection factor (APF)**

[Reserved]

**Atmosphere-supplying respirator** means a respirator that supplies the respirator user with breathing air from a source independent of the ambient atmosphere, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

**Canister or cartridge** means a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container.

**Demand respirator** means an atmosphere-supplying respirator that admits breathing air to the facepiece only when a negative pressure is created inside the facepiece by inhalation.

**Emergency situation** means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of an airborne contaminant.

**Employee exposure** means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

**End-of-service-life indicator (ESLI)** means a system that warns the respirator user of the approach of the end of adequate respiratory protection, for example, that the sorbent is approaching saturation or is no longer effective.

**Escape-only respirator** means a respirator intended to be used only for emergency exit.

**Filter or air purifying element** means a component used in respirators to remove solid or liquid aerosols from the inspired air.

**Filtering facepiece (dust mask)** means a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

**Fit factor** means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

**Fit test** means the use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test QLFT and Quantitative fit test QNFT.)

**Helmet** means a rigid respiratory inlet covering that also provides head protection against impact and penetration.

**High efficiency particulate air (HEPA) filter** means a filter that is at least 99.97% efficient in removing monodisperse particles of 0.3 micrometers in diameter. The equivalent

NIOSH 42 CFR 84 particulate filters are the N100, R100, and P100 filters.

**Hood** means a respiratory inlet covering that completely covers the head and neck and may also cover portions of the shoulders and torso.

**Immediately dangerous to life or health (IDLH)** means an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

**Interior structural firefighting** means the physical activity of fire suppression, rescue or both, inside of buildings or enclosed structures which are involved in a fire situation beyond the incipient stage. (See 29 CFR 1910.155)

**Loose-fitting facepiece** means a respiratory inlet covering that is designed to form a partial seal with the face.

**Maximum use concentration (MUC)**  
[Reserved].

**Negative pressure respirator (tight fitting)** means a respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

**Oxygen deficient atmosphere** means an atmosphere with an oxygen content below 19.5% by volume.

**Physician or other licensed health care professional (PLHCP)** means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required by paragraph (e) of this section.

**Positive pressure respirator** means a respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

**Powered air-purifying respirator (PAPR)** means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

**Pressure demand respirator** means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

**Qualitative fit test (QLFT)** means a pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

**Quantitative fit test (QNFT)** means an assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

**Respiratory inlet covering** means that portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or a mouthpiece respirator with nose clamp.

**Self-contained breathing apparatus (SCBA)** means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

**Service life** means the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer.

**Supplied-air respirator (SAR) or airline respirator** means an atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

**This section** means this respiratory protection standard.

**Tight-fitting facepiece** means a respiratory inlet covering that forms a complete seal with the face.

**User seal check** means an action conducted by the respirator user to determine if the respirator is properly seated to the face.

### **(c) Respiratory protection program.**

This paragraph requires the employer to develop and implement a written respiratory protection program with required worksite-specific procedures and elements for required respirator use.

The program must be administered by a suitably trained program administrator. In addition, certain program elements may be required for voluntary use to prevent potential hazards associated with the use of the respirator. The Small Entity Compliance Guide contains criteria for the selection of a program administrator and a sample program that meets the requirements of this paragraph. Copies of the Small Entity Compliance Guide will be available on or about April 8, 1998 from the Occupational Safety and Health Administration's Office of Publications, Room N 3101, 200 Constitution Avenue, NW, Washington, DC, 20210 (202-219-4667).

(1) In any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer, the employer shall establish and implement a written respiratory protection program with worksite-specific procedures. The program shall be updated as necessary to reflect those changes in workplace conditions that affect respirator use. The employer shall include in the program the following provisions of this section, as applicable:

(i) Procedures for selecting respirators for use in the workplace;

(ii) Medical evaluations of employees required to use respirators;

(iii) Fit testing procedures for tight-fitting respirators;

(iv) Procedures for proper use of respirators in routine and reasonably foreseeable emergency situations;

(v) Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators;

(vi) Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators;

(vii) Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations;

(viii) Training of employees in the proper use of respirators, including putting on and removing them, any limitations on their use, and their maintenance; and

(ix) Procedures for regularly evaluating the effectiveness of the program.

(2) Where respirator use is not required:

(i) An employer may provide respirators at the request of employees or permit employees to use their own respirators, if the employer determines that such respirator use will not in itself create a hazard. If the employer determines that any voluntary respirator use is permissible, the employer shall provide the respirator users with the information contained in Appendix D to this section ("Information for Employees Using Respirators When Not Required Under the Standard"); and

(ii) In addition, the employer must establish and implement those elements of a written respiratory protection program necessary to ensure that any employee using a respirator voluntarily is medically able to use that

respirator, and that the respirator is cleaned, stored, and maintained so that its use does not present a health hazard to the user.

Exception: Employers are not required to include in a written respiratory protection program those employees whose only use of respirators involves the voluntary use of filtering facepieces (dust masks).

(3) The employer shall designate a program administrator who is qualified by appropriate training or experience that is commensurate with the complexity of the program to administer or oversee the respiratory protection program and conduct the required evaluations of program effectiveness.

(4) The employer shall provide respirators, training, and medical evaluations at no cost to the employee.

#### **(d) Selection of respirators.**

This paragraph requires the employer to evaluate respiratory hazard(s) in the workplace, identify relevant workplace and user factors, and base respirator selection on these factors. The paragraph also specifies appropriately protective respirators for use in IDLH atmospheres, and limits the selection and use of air-purifying respirators.

##### **(1) General requirements.**

(i) The employer shall select and provide an appropriate respirator based on the respiratory hazard(s) to which the worker is exposed and workplace and user factors that affect respirator performance and reliability.

(ii) The employer shall select a NIOSH-certified respirator. The respirator shall be used in compliance with the conditions of its certification.

(iii) The employer shall identify and evaluate the respiratory hazard(s) in the workplace; this evaluation shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form. Where the employer cannot identify or reasonably estimate the employee exposure, the employer shall consider the atmosphere to be IDLH.

(iv) The employer shall select respirators from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

**(2) Respirators for IDLH atmospheres.**

(i) The employer shall provide the following respirators for employee use in IDLH atmospheres:

(A) A full facepiece pressure demand SCBA certified by NIOSH for a minimum service life of thirty minutes, or

(B) A combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply.

(ii) Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

(iii) All oxygen-deficient atmospheres shall be considered IDLH. Exception: If the employer demonstrates that, under all foreseeable conditions, the oxygen concentration can be maintained within the ranges specified in Table II of this section (i.e., for the altitudes set out in the table), then any atmosphere-supplying respirator may be used.

**(3) Respirators for atmospheres that are not IDLH.**

(i) The employer shall provide a respirator that is adequate to protect the health of the employee and ensure compliance with all other OSHA statutory and regulatory requirements, under routine and reasonably foreseeable emergency situations.

(A) Assigned Protection Factors (APFs)  
[Reserved]

(B) Maximum Use Concentration (MUC)  
[Reserved]

(ii) The respirator selected shall be appropriate for the chemical state and physical form of the contaminant.

(iii) For protection against gases and vapors, the employer shall provide:

(A) An atmosphere-supplying respirator, or

(B) An air-purifying respirator, provided that:

(1) The respirator is equipped with an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant; or

(2) If there is no ESLI appropriate for conditions in the employer's workplace, the employer implements a change schedule for canisters and cartridges that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life. The employer shall describe in the respirator program the information and data relied upon and the basis

for the canister and cartridge change schedule and the basis for reliance on the data.

(iv) For protection against particulates, the employer shall provide:

(A) An atmosphere-supplying respirator; or

(B) An air-purifying respirator equipped with a filter certified by NIOSH under 30 CFR part 11 as a high efficiency particulate air (HEPA) filter, or an air-purifying respirator equipped with a filter certified for particulates by NIOSH under 42 CFR part 84; or

(C) For contaminants consisting primarily of particles with mass median aerodynamic diameters (MMAD) of at least 2 micrometers, an air-purifying respirator equipped with any filter certified for particulates by NIOSH.

**TABLE I. -- Assigned Protection Factors [Reserved]**

**TABLE II**

Altitude (ft.)	Oxygen deficient atmospheres (%O <sub>2</sub> ) for which the employer may rely on atmosphere-supplying respirators
Less than 3,001.....	16.0-19.5
3,001-4,000.....	16.4-19.5
4,001-5,000.....	17.1-19.5
5,001-6,000.....	17.8-19.5
6,001-7,000.....	18.5-19.5
7,001-8,000 <sup>1</sup> .....	19.3-19.5

<sup>1</sup>Above 8,000 feet the exception does not apply. Oxygen-enriched breathing air must be supplied above 14,000 feet.

**(e) Medical evaluation.**

Using a respirator may place a physiological burden on employees that varies with the type of respirator worn, the job and workplace conditions in which the respirator is used, and the medical status of the employee. Accordingly, this paragraph specifies the minimum requirements for medical evaluation that employers must

implement to determine the employee's ability to use a respirator.

**(1) General.**

The employer shall provide a medical evaluation to determine the employee's ability to use a respirator, before the employee is fit tested or required to use the respirator in the workplace. The employer may discontinue an employee's medical evaluations when the employee is no longer required to use a respirator.

**(2) Medical evaluation procedures.**

The employer shall identify a physician or other licensed health care professional (PLHCP) to perform medical evaluations using a medical questionnaire or an initial medical examination that obtains the same information as the medical questionnaire.

(ii) The medical evaluation shall obtain the information requested by the questionnaire in Sections 1 and 2, Part A of Appendix C of this section.

**(3) Follow-up medical examination.**

(i) The employer shall ensure that a follow-up medical examination is provided for an employee who gives a positive response to any question among questions 1 through 8 in Section 2, Part A of Appendix C or whose initial medical examination demonstrates the need for a follow-up medical examination.

(ii) The follow-up medical examination shall include any medical tests, consultations, or diagnostic procedures that the PLHCP deems necessary to make a final determination.

**(4) Administration of the medical questionnaire and examinations.**

(i) The medical questionnaire and examinations shall be administered confidentially during the employee's normal working hours or at a time and place convenient to the employee. The medical questionnaire shall be administered in a manner that ensures that the employee understands its content.

(ii) The employer shall provide the employee with an opportunity to discuss the questionnaire and examination results with the PLHCP.

**(5) Supplemental information for the PLHCP.**

(i) The following information must be provided to the PLHCP before the PLHCP makes a recommendation concerning an employee's ability to use a respirator:

(A) The type and weight of the respirator to be used by the employee;

(B) The duration and frequency of respirator use (including use for rescue and escape);

(C) The expected physical work effort;

(D) Additional protective clothing and equipment to be worn; and

(E) Temperature and humidity extremes that may be encountered.

(ii) Any supplemental information provided previously to the PLHCP regarding an employee need not be provided for a subsequent medical evaluation if the information and the PLHCP remain the same.

(iii) The employer shall provide the PLHCP with a copy of the written respiratory protection program and a copy of this section.

**Note to Paragraph (e)(5)(iii):** When the employer replaces a PLHCP, the employer must ensure that the new PLHCP obtains this information, either by providing the documents directly to the PLHCP or having the documents transferred from the former PLHCP to the new PLHCP. However, OSHA does not expect employers to have employees medically reevaluated solely because a new PLHCP has been selected.

**(6) Medical determination.**

In determining the employee's ability to use a respirator, the employer shall:

(i) Obtain a written recommendation regarding the employee's ability to use the respirator from the PLHCP. The recommendation shall provide only the following information:

(A) Any limitations on respirator use related to the medical condition of the employee, or relating to the workplace conditions in which the respirator will be used, including whether or not the employee is medically able to use the respirator;

(B) The need, if any, for follow-up medical evaluations; and

(C) A statement that the PLHCP has provided the employee with a copy of the PLHCP's written recommendation.

(ii) If the respirator is a negative pressure respirator and the PLHCP finds a medical condition that may place the employee's health at increased risk if the respirator is used, the employer shall provide a PAPR if the PLHCP's medical evaluation finds that the employee can use such a respirator; if a subsequent medical evaluation finds that the employee is medically

able to use a negative pressure respirator, then the employer is no longer required to provide a PAPR.

**(7) Additional medical evaluations.**

At a minimum, the employer shall provide additional medical evaluations that comply with the requirements of this section if:

(i) An employee reports medical signs or symptoms that are related to ability to use a respirator;

(ii) A PLHCP, supervisor, or the respirator program administrator informs the employer that an employee needs to be reevaluated;

(iii) Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation; or

(iv) A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.

**(f) Fit testing.**

This paragraph requires that, before an employee may be required to use any respirator with a negative or positive pressure tight-fitting facepiece, the employee must be fit tested with the same make, model, style, and size of respirator that will be used. This paragraph specifies the kinds of fit tests allowed, the procedures for conducting them, and how the results of the fit tests must be used.

(1) The employer shall ensure that employees using a tight-fitting facepiece respirator pass an appropriate qualitative fit test (QLFT) or quantitative fit test (QNFT) as stated in this paragraph.

(2) The employer shall ensure that an employee using a tight-fitting facepiece respirator is fit tested prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually thereafter.

(3) The employer shall conduct an additional fit test whenever the employee reports, or the employer, PLHCP, supervisor, or program administrator makes visual observations of, changes in the employee's physical condition that could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.

(4) If after passing a QLFT or QNFT, the employee subsequently notifies the employer, program administrator, supervisor, or PLHCP that the fit of the respirator is unacceptable, the employee shall be given a reasonable opportunity to select a different respirator facepiece and to be retested.

(5) The fit test shall be administered using an OSHA-accepted QLFT or QNFT protocol. The OSHA-accepted QLFT and QNFT protocols and procedures are contained in Appendix A of this section.

(6) QLFT may only be used to fit test negative pressure air-purifying respirators that must achieve a fit factor of 100 or less.

(7) If the fit factor, as determined through an OSHA-accepted QNFT protocol, is equal to or greater than 100 for tight-fitting half facepieces, or equal to or greater than 500 for tight-fitting full facepieces, the QNFT has been passed with that respirator.

(8) Fit testing of tight-fitting atmosphere-supplying respirators and tight-fitting powered air-purifying respirators shall be accomplished by performing quantitative or qualitative fit testing in the negative pressure mode, regardless of the mode of operation (negative or positive pressure) that is used for respiratory protection.

(i) Qualitative fit testing of these respirators shall be accomplished by temporarily converting the respirator user's actual facepiece into a negative pressure respirator with appropriate filters, or by using an identical negative pressure air-purifying respirator facepiece with the same sealing surfaces as a surrogate for the atmosphere-supplying or powered air-purifying respirator facepiece.

(ii) Quantitative fit testing of these respirators shall be accomplished by modifying the facepiece to allow sampling inside the facepiece in the breathing zone of the user, midway between the nose and mouth. This requirement shall be accomplished by installing a permanent sampling probe onto a surrogate facepiece, or by using a sampling adapter designed to temporarily provide a means of sampling air from inside the facepiece.

(iii) Any modifications to the respirator facepiece for fit testing shall be completely removed, and the facepiece restored to NIOSH-approved configuration, before that facepiece can be used in the workplace.

**(g) Use of respirators.**

This paragraph requires employers to establish and implement procedures for the proper use of respirators. These requirements include prohibiting conditions that may result in facepiece seal leakage, preventing employees from removing respirators in hazardous environments, taking actions to ensure continued effective respirator operation throughout the work shift, and establishing procedures for the use of respirators in IDLH atmospheres or in interior structural firefighting situations.

**(1) Facepiece seal protection.**

(i) The employer shall not permit respirators with tight-fitting facepieces to be worn by employees who have:

(A) Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or

(B) Any condition that interferes with the face-to-facepiece seal or valve function.

(ii) If an employee wears corrective glasses or goggles or other personal protective equipment, the employer shall ensure that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user.

(iii) For all tight-fitting respirators, the employer shall ensure that employees perform a user seal check each time they put on the respirator using the procedures in Appendix B-1 or procedures recommended by the respirator manufacturer that the employer demonstrates are as effective as those in Appendix B-1 of this section.

**(2) Continuing respirator effectiveness.**

(i) Appropriate surveillance shall be maintained of work area conditions and degree of employee exposure or stress. When there is a change in work area conditions or degree of employee exposure or stress that may affect respirator effectiveness, the employer shall reevaluate the continued effectiveness of the respirator.

(ii) The employer shall ensure that employees leave the respirator use area:

(A) To wash their faces and respirator facepieces as necessary to prevent eye or skin irritation associated with respirator use; or

(B) If they detect vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece; or

(C) To replace the respirator or the filter, cartridge, or canister elements.

(iii) If the employee detects vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece, the employer must replace or repair the respirator before allowing the employee to return to the work area.

**(3) Procedures for IDLH atmospheres.**

For all IDLH atmospheres, the employer shall ensure that:

(i) One employee or, when needed, more than one employee is located outside the IDLH atmosphere;

(ii) Visual, voice, or signal line communication is maintained between the employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere;

(iii) The employee(s) located outside the IDLH atmosphere are trained and equipped to provide effective emergency rescue;

(iv) The employer or designee is notified before the employee(s) located outside the IDLH atmosphere enter the IDLH atmosphere to provide emergency rescue;

(v) The employer or designee authorized to do so by the employer, once notified, provides necessary assistance appropriate to the situation;

(vi) Employee(s) located outside the IDLH atmospheres are equipped with:

(A) Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either

(B) Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or

(C) Equivalent means for rescue where retrieval equipment is not required under paragraph (g)(3)(vi)(B).

**(4) Procedures for interior structural firefighting.**

In addition to the requirements set forth under paragraph (g)(3), in interior structural fires, the employer shall ensure that:

(i) At least two employees enter the IDLH atmosphere and remain in visual or voice contact with one another at all times;

(ii) At least two employees are located outside the IDLH atmosphere; and

(iii) All employees engaged in interior structural firefighting use SCBAs.

**Note 1 to paragraph (g):** One of the two individuals located outside the IDLH atmosphere may be assigned to an additional role, such as incident commander in charge of the emergency or safety officer, so long as this individual is able to perform assistance or rescue activities without jeopardizing the safety or health of any firefighter working at the incident.

**Note 2 to paragraph (g):** Nothing in this section is meant to preclude firefighters from performing emergency rescue activities before an entire team has assembled.

#### **(h) Maintenance and care of respirators.**

This paragraph requires the employer to provide for the cleaning and disinfecting, storage, inspection, and repair of respirators used by employees.

##### **(1) Cleaning and disinfecting.**

The employer shall provide each respirator user with a respirator that is clean, sanitary, and in good working order. The employer shall ensure that respirators are cleaned and disinfected using the procedures in Appendix B-2 of this section, or procedures recommended by the respirator manufacturer, provided that such procedures are of equivalent effectiveness. The respirators shall be cleaned and disinfected at the following intervals:

(i) Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition;

(ii) Respirators issued to more than one employee shall be cleaned and disinfected before being worn by different individuals;

(iii) Respirators maintained for emergency use shall be cleaned and disinfected after each use; and

(iv) Respirators used in fit testing and training shall be cleaned and disinfected after each use.

##### **(2) Storage.**

The employer shall ensure that respirators are stored as follows:

(i) All respirators shall be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals, and they shall be packed or stored to prevent deformation of the facepiece and exhalation valve.

(ii) In addition to the requirements of paragraph (h)(2)(i) of this section, emergency respirators shall be:

(A) Kept accessible to the work area;

(B) Stored in compartments or in covers that are clearly marked as containing emergency respirators; and

(C) Stored in accordance with any applicable manufacturer instructions.

##### **(3) Inspection.**

(i) The employer shall ensure that respirators are inspected as follows:

(A) All respirators used in routine situations shall be inspected before each use and during cleaning;

(B) All respirators maintained for use in emergency situations shall be inspected at least monthly and in accordance with the manufacturer's recommendations, and shall be checked for proper function before and after each use; and

(C) Emergency escape-only respirators shall be inspected before being carried into the workplace for use.

(ii) The employer shall ensure that respirator inspections include the following:

(A) A check of respirator function, tightness of connections, and the condition of the various parts including, but not limited to, the facepiece, head straps, valves, connecting tube, and cartridges, canisters or filters; and

(B) A check of elastomeric parts for pliability and signs of deterioration.

(iii) In addition to the requirements of paragraphs (h)(3)(i) and (ii) of this section, self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be maintained in a fully charged state and shall be recharged when the pressure falls to 90% of the manufacturer's recommended pressure level. The employer shall determine that the regulator and warning devices function properly.

(iv) For respirators maintained for emergency use, the employer shall:

(A) Certify the respirator by documenting the date the inspection was performed, the name (or signature) of the person who made the inspection, the findings, required remedial action, and a serial number or other means of identifying the inspected respirator; and

(B) Provide this information on a tag or label that is attached to the storage compartment for the respirator, is kept with the respirator, or is

included in inspection reports stored as paper or electronic files. This information shall be maintained until replaced following a subsequent certification.

**(4) Repairs.**

The employer shall ensure that respirators that fail an inspection or are otherwise found to be defective are removed from service, and are discarded or repaired or adjusted in accordance with the following procedures:

(i) Repairs or adjustments to respirators are to be made only by persons appropriately trained to perform such operations and shall use only the respirator manufacturer's NIOSH-approved parts designed for the respirator;

(ii) Repairs shall be made according to the manufacturer's recommendations and specifications for the type and extent of repairs to be performed; and

(iii) Reducing and admission valves, regulators, and alarms shall be adjusted or repaired only by the manufacturer or a technician trained by the manufacturer.

**(i) Breathing air quality and use.**

This paragraph requires the employer to provide employees using atmosphere-supplying respirators (supplied-air and SCBA) with breathing gases of high purity.

(1) The employer shall ensure that compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration accords with the following specifications:

(i) Compressed and liquid oxygen shall meet the United States Pharmacopoeia requirements for medical or breathing oxygen; and

(ii) Compressed breathing air shall meet at least the requirements for Grade D breathing air described in ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989, to include:

(A) Oxygen content (v/v) of 19.5-23.5%;

(B) Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;

(C) Carbon monoxide (CO) content of 10 ppm or less;

(D) Carbon dioxide content of 1,000 ppm or less; and

(E) Lack of noticeable odor.

(2) The employer shall ensure that compressed oxygen is not used in atmosphere-

supplying respirators that have previously used compressed air.

(3) The employer shall ensure that oxygen concentrations greater than 23.5% are used only in equipment designed for oxygen service or distribution.

(4) The employer shall ensure that cylinders used to supply breathing air to respirators meet the following requirements:

(i) Cylinders are tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR part 173 and part 178);

(ii) Cylinders of purchased breathing air have a certificate of analysis from the supplier that the breathing air meets the requirements for Grade D breathing air; and

(iii) The moisture content in the cylinder does not exceed a dew point of -50 deg.F (-45.6 deg.C) at 1 atmosphere pressure.

(5) The employer shall ensure that compressors used to supply breathing air to respirators are constructed and situated so as to:

(i) Prevent entry of contaminated air into the air-supply system;

(ii) Minimize moisture content so that the dew point at 1 atmosphere pressure is 10 degrees F (5.56 deg.C) below the ambient temperature;

(iii) Have suitable in-line air-purifying sorbent beds and filters to further ensure breathing air quality. Sorbent beds and filters shall be maintained and replaced or refurbished periodically following the manufacturer's instructions.

(iv) Have a tag containing the most recent change date and the signature of the person authorized by the employer to perform the change. The tag shall be maintained at the compressor.

(6) For compressors that are not oil-lubricated, the employer shall ensure that carbon monoxide levels in the breathing air do not exceed 10 ppm.

(7) For oil-lubricated compressors, the employer shall use a high-temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. If only high-temperature alarms are used, the air supply shall be monitored at intervals sufficient to prevent carbon monoxide in the breathing air from exceeding 10 ppm.

(8) The employer shall ensure that breathing air couplings are incompatible with outlets for nonrespirable worksite air or other gas systems.

No asphyxiating substance shall be introduced into breathing air lines.

(9) The employer shall use breathing gas containers marked in accordance with the NIOSH respirator certification standard, 42 CFR part 84.

**(j) Identification of filters, cartridges, and canisters.**

The employer shall ensure that all filters, cartridges and canisters used in the workplace are labeled and color coded with the NIOSH approval label and that the label is not removed and remains legible.

**(k) Training and information.**

This paragraph requires the employer to provide effective training to employees who are required to use respirators. The training must be comprehensive, understandable, and recur annually, and more often if necessary. This paragraph also requires the employer to provide the basic information on respirators in Appendix D of this section to employees who wear respirators when not required by this section or by the employer to do so.

(1) The employer shall ensure that each employee can demonstrate knowledge of at least the following:

(i) Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;

(ii) What the limitations and capabilities of the respirator are;

(iii) How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;

(iv) How to inspect, put on and remove, use, and check the seals of the respirator;

(v) What the procedures are for maintenance and storage of the respirator;

(vi) How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and

(vii) The general requirements of this section.

(2) The training shall be conducted in a manner that is understandable to the employee.

(3) The employer shall provide the training prior to requiring the employee to use a respirator in the workplace.

(4) An employer who is able to demonstrate that a new employee has received training within

the last 12 months that addresses the elements specified in paragraph (k)(1)(i) through (vii) is not required to repeat such training provided that, as required by paragraph (k)(1), the employee can demonstrate knowledge of those element(s). Previous training not repeated initially by the employer must be provided no later than 12 months from the date of the previous training.

(5) Retraining shall be administered annually, and when the following situations occur:

(i) Changes in the workplace or the type of respirator render previous training obsolete;

(ii) Inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill; or

(iii) Any other situation arises in which retraining appears necessary to ensure safe respirator use.

(6) The basic advisory information on respirators, as presented in Appendix D of this section, shall be provided by the employer in any written or oral format, to employees who wear respirators when such use is not required by this section or by the employer.

**(l) Program evaluation.**

This section requires the employer to conduct evaluations of the workplace to ensure that the written respiratory protection program is being properly implemented, and to consult employees to ensure that they are using the respirators properly.

(1) The employer shall conduct evaluations of the workplace as necessary to ensure that the provisions of the current written program are being effectively implemented and that it continues to be effective.

(2) The employer shall regularly consult employees required to use respirators to assess the employees' views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include, but are not limited to:

(i) Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);

(ii) Appropriate respirator selection for the hazards to which the employee is exposed;

(iii) Proper respirator use under the workplace conditions the employee encounters; and

(iv) Proper respirator maintenance.

**(m) Recordkeeping.**

This section requires the employer to establish and retain written information regarding medical evaluations, fit testing, and the respirator program. This information will facilitate employee involvement in the respirator program, assist the employer in auditing the adequacy of the program, and provide a record for compliance determinations by OSHA.

**(1) Medical evaluation.**

Records of medical evaluations required by this section must be retained and made available in accordance with 29 CFR 1910.1020.

**(2) Fit testing.**

(i) The employer shall establish a record of the qualitative and quantitative fit tests administered to an employee including:

(A) The name or identification of the employee tested;

(B) Type of fit test performed;

(C) Specific make, model, style, and size of respirator tested;

(D) Date of test; and

(E) The pass/fail results for QLFTs or the fit factor and strip chart recording or other recording of the test results for QNFTs.

(ii) Fit test records shall be retained for respirator users until the next fit test is administered.

(3) A written copy of the current respirator program shall be retained by the employer.

(4) Written materials required to be retained under this paragraph shall be made available upon request to affected employees and to the Assistant Secretary or designee for examination and copying.

**(n) Dates.**

**(1) Effective date.**

This section is effective April 8, 1998. The obligations imposed by this section commence on the effective date unless otherwise noted in this paragraph. Compliance with obligations that do not commence on the effective date shall occur no later than the applicable start-up date.

**(2) Compliance dates.**

All obligations of this section commence on the effective date except as follows:

(i) The determination that respirator use is required (paragraph (a)) shall be completed no later than September 8, 1998.

(ii) Compliance with provisions of this section for all other provisions shall be completed no later than October 5, 1998.

(3) The provisions of 29 CFR 1910.134 and 29 CFR 1926.103, contained in the 29 CFR parts 1900 to 1910.99 and the 29 CFR part 1926 editions, revised as of July 1, 1997, are in effect and enforceable until October 5, 1998, or during any administrative or judicial stay of the provisions of this section.

**(4) Existing Respiratory Protection Programs.**

If, in the 12 month period preceding April 8, 1998, the employer has conducted annual respirator training, fit testing, respirator program evaluation, or medical evaluations, the employer may use the results of those activities to comply with the corresponding provisions of this section, providing that these activities were conducted in a manner that meets the requirements of this section.

**(o) Appendices.**

(1) Compliance with Appendix A, Appendix B-1, Appendix B-2, and Appendix C of this section is mandatory.

(2) Appendix D of this section is non-mandatory and is not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

[63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998]

**Appendix A to § 1910.134: Fit Testing Procedures (Mandatory)**

**Part I. OSHA-Accepted Fit Test Protocols**

**A. Fit Testing Procedures—General Requirements**

The employer shall conduct fit testing using the following procedures. The requirements in this appendix apply to all OSHA-accepted fit test methods, both QLFT and QNFT.

1. The test subject shall be allowed to pick the most acceptable respirator from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

2. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine an acceptable fit. A mirror shall be available to assist the subject in evaluating the fit and positioning of the respirator. This instruction may not constitute the subject's formal training on respirator use, because it is only a review.

3. The test subject shall be informed that he/she is being asked to select the respirator that provides the most acceptable fit.

Each respirator represents a different size and shape, and if fitted and used properly, will provide adequate protection.

4. The test subject shall be instructed to hold each chosen facepiece up to the face and eliminate those that obviously do not give an acceptable fit.

5. The more acceptable facepieces are noted in case the one selected proves unacceptable; the most comfortable mask is donned and worn at least five minutes to assess comfort. Assistance in assessing comfort can be given by discussing the points in the following item A.6. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.

6. Assessment of comfort shall include a review of the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:

- (a) Position of the mask on the nose
- (b) Room for eye protection
- (c) Room to talk
- (d) Position of mask on face and cheeks

7. The following criteria shall be used to help determine the adequacy of the respirator fit:

- (a) Chin properly placed;
- (b) Adequate strap tension, not overly tightened;
- (c) Fit across nose bridge;
- (d) Respirator of proper size to span distance from nose to chin;
- (e) Tendency of respirator to slip;

(f) Self-observation in mirror to evaluate fit and respirator position.

8. The test subject shall conduct a user seal check, either the negative and positive pressure seal checks described in Appendix B-1 of this section or those recommended by the respirator manufacturer which provide equivalent protection to the procedures in Appendix B-1. Before conducting the negative and positive pressure checks, the subject shall be told to seat the mask on the face by moving the head from side-to-side and up and down slowly while taking in a few slow deep breaths. Another facepiece shall be selected and retested if the test subject fails the user seal check tests.

9. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface, such as stubble beard growth, beard, mustache or sideburns which cross the respirator sealing surface. Any type of apparel which interferes with a satisfactory fit shall be altered or removed.

10. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician or other licensed health care professional, as appropriate, to determine whether the test subject can wear a respirator while performing her or his duties.

11. If the employee finds the fit of the respirator unacceptable, the test subject shall be given the opportunity to select a different respirator and to be retested.

12. Exercise regimen. Prior to the commencement of the fit test, the test subject shall be given a description of the fit test and the test subject's responsibilities during the test procedure. The description of the process shall include a description of the test exercises that the subject will be performing. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.

13. The fit test shall be performed while the test subject is wearing any applicable safety equipment that may be worn during actual respirator use which could interfere with respirator fit.

14. Test Exercises. (a) The following test exercises are to be performed for all fit testing methods prescribed in this appendix, except for the CNP method. A separate fit testing exercise regimen is contained in the CNP protocol. The test subject shall perform exercises, in the test environment, in the following manner:

(1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally.

(2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as not to hyperventilate.

(3) Turning head side to side. Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side.

(4) Moving head up and down. Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).

(5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.

### **Rainbow Passage**

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

(6) Grimace. The test subject shall grimace by smiling or frowning. (This applies only to QNFT testing; it is not performed for QLFT)

(7) Bending over. The test subject shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments such as shroud type QNFT or QLFT units that do not permit bending over at the waist.

(8) Normal breathing. Same as exercise (1).

(b) Each test exercise shall be performed for one minute except for the grimace exercise which shall be performed for 15 seconds. The test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall

be tried. The respirator shall not be adjusted once the fit test exercises begin. Any adjustment voids the test, and the fit test must be repeated.

## **B. Qualitative Fit Test (QLFT) Protocols**

### **1. General**

(a) The employer shall ensure that persons administering QLFT are able to prepare test solutions, calibrate equipment and perform tests properly, recognize invalid tests, and ensure that test equipment is in proper working order.

(b) The employer shall ensure that QLFT equipment is kept clean and well maintained so as to operate within the parameters for which it was designed.

### **2. Isoamyl Acetate Protocol**

Note: This protocol is not appropriate to use for the fit testing of particulate respirators. If used to fit test particulate respirators, the respirator must be equipped with an organic vapor filter.

#### **(a) Odor Threshold Screening**

Odor threshold screening, performed without wearing a respirator, is intended to determine if the individual tested can detect the odor of isoamyl acetate at low levels.

(1) Three 1 liter glass jars with metal lids are required.

(2) Odor-free water (e.g., distilled or spring water) at approximately 25 deg. C (77 deg. F) shall be used for the solutions.

(3) The isoamyl acetate (IAA) (also known as isopentyl acetate) stock solution is prepared by adding 1 ml of pure IAA to 800 ml of odor-free water in a 1 liter jar, closing the lid and shaking for 30 seconds. A new solution shall be prepared at least weekly.

(4) The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well-ventilated to prevent the odor of IAA from becoming evident in the general room air where testing takes place.

(5) The odor test solution is prepared in a second jar by placing 0.4 ml of the stock solution into 500 ml of odor-free water using a clean dropper or pipette. The solution shall be shaken for 30 seconds and allowed to stand for two to three minutes so that the IAA concentration

above the liquid may reach equilibrium. This solution shall be used for only one day.

(6) A test blank shall be prepared in a third jar by adding 500 cc of odor-free water.

(7) The odor test and test blank jar lids shall be labeled (e.g., 1 and 2) for jar identification. Labels shall be placed on the lids so that they can be peeled off periodically and switched to maintain the integrity of the test.

(8) The following instruction shall be typed on a card and placed on the table in front of the two test jars (i.e., 1 and 2): "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."

(9) The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.

(10) If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA qualitative fit test shall not be performed.

(11) If the test subject correctly identifies the jar containing the odor test solution, the test subject may proceed to respirator selection and fit testing.

#### **(b) Isoamyl Acetate Fit Test**

(1) The fit test chamber shall be a clear 55-gallon drum liner suspended inverted over a 2-foot diameter frame so that the top of the chamber is about 6 inches above the test subject's head. If no drum liner is available, a similar chamber shall be constructed using plastic sheeting. The inside top center of the chamber shall have a small hook attached.

(2) Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors.

(3) After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection, and shall be well-ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.

(4) A copy of the test exercises and any prepared text from which the subject is to read shall be taped to the inside of the test chamber.

(5) Upon entering the test chamber, the test subject shall be given a 6-inch by 5-inch piece of paper towel, or other porous, absorbent, single-ply material, folded in half and wetted with 0.75 ml of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber. An IAA test swab or ampule may be substituted for the IAA wetted paper towel provided it has been demonstrated that the alternative IAA source will generate an IAA test atmosphere with a concentration equivalent to that generated by the paper towel method.

(6) Allow two minutes for the IAA test concentration to stabilize before starting the fit test exercises. This would be an appropriate time to talk with the test subject; to explain the fit test, the importance of his/her cooperation, and the purpose for the test exercises; or to demonstrate some of the exercises.

(7) If at any time during the test, the subject detects the banana-like odor of IAA, the test is failed. The subject shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

(8) If the test is failed, the subject shall return to the selection room and remove the respirator. The test subject shall repeat the odor sensitivity test, select and put on another respirator, return to the test area and again begin the fit test procedure described in (b) (1) through (7) above. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait at least 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

(9) If the subject passes the test, the efficiency of the test procedure shall be demonstrated by having the subject break the respirator face seal and take a breath before exiting the chamber.

(10) When the test subject leaves the chamber, the subject shall remove the saturated towel and return it to the person conducting the test, so that there is no significant IAA concentration buildup in the chamber during subsequent tests. The used towels shall be kept in a self-sealing plastic bag to keep the test area from being contaminated.

### 3. Saccharin Solution Aerosol Protocol

The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

#### (a) Taste threshold screening.

The saccharin taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of saccharin.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches in diameter by 14 inches tall with at least the front portion clear and that allows free movements of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a 3/4-inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his/her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a sweet taste.

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the threshold check solution into the enclosure. The nozzle is directed away from the nose and mouth of the person. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The threshold check solution is prepared by dissolving 0.83 gram of sodium saccharin USP in 100 ml of warm water. It can be prepared by putting 1 ml of the fit test solution (see (b)(5) below) in 100 ml of distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then released and allowed to fully expand.

(7) Ten squeezes are repeated rapidly and then the test subject is asked whether the saccharin can be tasted. If the test subject reports tasting the sweet taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test

subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted. If the test subject reports tasting the sweet taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the saccharin is not tasted after 30 squeezes (step 10), the test subject is unable to taste saccharin and may not perform the saccharin fit test.

**Note to paragraph 3. (a):** If the test subject eats or drinks something sweet before the screening test, he/she may be unable to taste the weak saccharin solution.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at least each morning and afternoon or at least every four hours.

#### (b) Saccharin solution aerosol fit test procedure.

(1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure described in 3. (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected in section I. A. of this appendix. The respirator shall be properly adjusted and equipped with a particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 ml of warm water.

(6) As before, the test subject shall breathe through the slightly open mouth with tongue extended, and report if he/she tastes the sweet taste of saccharin.

(7) The nebulizer is inserted into the hole in the front of the enclosure and an initial concentration of saccharin fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test. A minimum of 10 squeezes is required.

(8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A.14. of this appendix.

(9) Every 30 seconds the aerosol concentration shall be replenished using one half the original number of squeezes used initially (e.g., 5, 10 or 15).

(10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of saccharin is detected. If the test subject does not report tasting the saccharin, the test is passed.

(11) If the taste of saccharin is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

(12) Since the nebulizer has a tendency to clog during use, the test operator must make periodic checks of the nebulizer to ensure that it is not clogged. If clogging is found at the end of the test session, the test is invalid.

#### **4. Bitrex™ (denatonium benzoate) Solution Aerosol Qualitative Fit Test Protocol**

The Bitrex™ (denatonium benzoate) solution aerosol QLFT protocol uses the published saccharin test protocol because that protocol is widely accepted. Bitrex is routinely used as a taste aversion agent in household liquids which children should not be drinking and is endorsed by the American Medical Association, the National Safety Council, and the American Association of Poison Control Centers. The entire screening and testing procedure shall

be explained to the test subject prior to the conduct of the screening test.

##### **(a) Taste Threshold Screening.**

The Bitrex taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of Bitrex.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches (30.5 cm) in diameter by 14 inches (35.6 cm) tall. The front portion of the enclosure shall be clear from the respirator and allow free movement of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a 3/4 inch (1.9 cm) hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his or her slightly open mouth with tongue extended. The subject is instructed to report when he/she detects a bitter taste.

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, the test conductor shall spray the Threshold Check Solution into the enclosure. This Nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The Threshold Check Solution is prepared by adding 13.5 milligrams of Bitrex to 100 ml of 5% salt (NaCl) solution in distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that the bulb collapses completely, and is then released and allowed to fully expand.

(7) An initial ten squeezes are repeated rapidly and then the test subject is asked whether the Bitrex can be tasted. If the test subject reports tasting the bitter taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the second ten squeezes, the screening test is completed. The taste threshold

is noted as twenty regardless of the number of squeezes actually completed.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the Bitrex is tasted. If the test subject reports tasting the bitter taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the Bitrex is not tasted after 30 squeezes (step 10), the test subject is unable to taste Bitrex and may not perform the Bitrex fit test.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken to dry, and refilled at least each morning and afternoon or at least every four hours.

#### **(b) Bitrex Solution Aerosol Fit Test Procedure.**

(1) The test subject may not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure as that described in 4. (a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected according to section I. A. of this appendix. The respirator shall be properly adjusted and equipped with any type particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 337.5 mg of Bitrex to 200 ml of a 5% salt (NaCl) solution in warm water.

(6) As before, the test subject shall breathe through his or her slightly open mouth with tongue extended, and be instructed to report if he/she tastes the bitter taste of Bitrex.

(7) The nebulizer is inserted into the hole in the front of the enclosure and an initial

concentration of the fit test solution is sprayed into the enclosure using the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test.

(8) After generating the aerosol, the test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(9) Every 30 seconds the aerosol concentration shall be replenished using one half the number of squeezes used initially (e.g., 5, 10 or 15).

(10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of Bitrex is detected. If the test subject does not report tasting the Bitrex, the test is passed.

(11) If the taste of Bitrex is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator shall be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

#### **5. Irritant Smoke (Stannic Chloride) Protocol**

This qualitative fit test uses a person's response to the irritating chemicals released in the "smoke" produced by a stannic chloride ventilation smoke tube to detect leakage into the respirator.

##### **(a) General Requirements and Precautions**

(1) The respirator to be tested shall be equipped with high efficiency particulate air (HEPA) or P100 series filter(s).

(2) Only stannic chloride smoke tubes shall be used for this protocol.

(3) No form of test enclosure or hood for the test subject shall be used.

(4) The smoke can be irritating to the eyes, lungs, and nasal passages. The test conductor shall take precautions to minimize the test subject's exposure to irritant smoke. Sensitivity varies, and certain individuals may respond to a greater degree to irritant smoke. Care shall be taken when performing the sensitivity screening checks that determine whether the test subject can detect irritant smoke to use only the minimum amount of smoke necessary to elicit a response from the test subject.

(5) The fit test shall be performed in an area with adequate ventilation to prevent exposure of

the person conducting the fit test or the build-up of irritant smoke in the general atmosphere.

**(b) Sensitivity Screening Check**

The person to be tested must demonstrate his or her ability to detect a weak concentration of the irritant smoke.

(1) The test operator shall break both ends of a ventilation smoke tube containing stannic chloride, and attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute, or an aspirator squeeze bulb. The test operator shall cover the other end of the smoke tube with a short piece of tubing to prevent potential injury from the jagged end of the smoke tube.

(2) The test operator shall advise the test subject that the smoke can be irritating to the eyes, lungs, and nasal passages and instruct the subject to keep his/her eyes closed while the test is performed.

(3) The test subject shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its irritating properties and to determine if he/she can detect the irritating properties of the smoke. The test operator shall carefully direct a small amount of the irritant smoke in the test subject's direction to determine that he/she can detect it.

**(c) Irritant Smoke Fit Test Procedure**

(1) The person being fit tested shall don the respirator without assistance, and perform the required user seal check(s).

(2) The test subject shall be instructed to keep his/her eyes closed.

(3) The test operator shall direct the stream of irritant smoke from the smoke tube toward the face seal area of the test subject, using the low flow pump or the squeeze bulb. The test operator shall begin at least 12 inches from the facepiece and move the smoke stream around the whole perimeter of the mask. The operator shall gradually make two more passes around the perimeter of the mask, moving to within six inches of the respirator.

(4) If the person being tested has not had an involuntary response and/or detected the irritant smoke, proceed with the test exercises.

(5) The exercises identified in section I.A. 14. of this appendix shall be performed by the test subject while the respirator seal is being continually challenged by the smoke, directed around the perimeter of the respirator at a distance of six inches.

(6) If the person being fit tested reports detecting the irritant smoke at any time, the test is failed. The person being retested must repeat the entire sensitivity check and fit test procedure.

(7) Each test subject passing the irritant smoke test without evidence of a response (involuntary cough, irritation) shall be given a second sensitivity screening check, with the smoke from the same smoke tube used during the fit test, once the respirator has been removed, to determine whether he/she still reacts to the smoke. Failure to evoke a response shall void the fit test.

(8) If a response is produced during this second sensitivity check, then the fit test is passed.

**C. Quantitative Fit Test (QNFT) Protocols**

The following quantitative fit testing procedures have been demonstrated to be acceptable: Quantitative fit testing using a non-hazardous test aerosol (such as corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS], or sodium chloride) generated in a test chamber, and employing instrumentation to quantify the fit of the respirator; Quantitative fit testing using ambient aerosol as the test agent and appropriate instrumentation (condensation nuclei counter) to quantify the respirator fit; Quantitative fit testing using controlled negative pressure and appropriate instrumentation to measure the volumetric leak rate of a facepiece to quantify the respirator fit.

**1. General**

(a) The employer shall ensure that persons administering QNFT are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly and ensure that test equipment is in proper working order.

(b) The employer shall ensure that QNFT equipment is kept clean, and is maintained and calibrated according to the manufacturer's instructions so as to operate at the parameters for which it was designed.

## **2. Generated Aerosol Quantitative Fit Testing Protocol**

### **(a) Apparatus.**

(1) Instrumentation. Aerosol generation, dilution, and measurement systems using particulates (corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS] or sodium chloride) as test aerosols shall be used for quantitative fit testing.

(2) Test chamber. The test chamber shall be large enough to permit all test subjects to perform freely all required exercises without disturbing the test agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the test agent is effectively isolated from the ambient air, yet uniform in concentration throughout the chamber.

(3) When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high efficiency particulate air (HEPA) or P100 series filter supplied by the same manufacturer.

(4) The sampling instrument shall be selected so that a computer record or strip chart record may be made of the test showing the rise and fall of the test agent concentration with each inspiration and expiration at fit factors of at least 2,000. Integrators or computers that integrate the amount of test agent penetration leakage into the respirator for each exercise may be used provided a record of the readings is made.

(5) The combination of substitute air-purifying elements, test agent and test agent concentration shall be such that the test subject is not exposed in excess of an established exposure limit for the test agent at any time during the testing process, based upon the length of the exposure and the exposure limit duration.

(6) The sampling port on the test specimen respirator shall be placed and constructed so that no leakage occurs around the port (e.g., where the respirator is probed), a free air flow is allowed into the sampling line at all times, and there is no interference with the fit or performance of the respirator. The in-mask sampling device (probe) shall be designed and used so that the air sample is drawn from the breathing zone of the test subject, midway between the nose and mouth and with the probe extending into the facepiece cavity at least 1/4 inch.

(7) The test setup shall permit the person administering the test to observe the test subject inside the chamber during the test.

(8) The equipment generating the test atmosphere shall maintain the concentration of test agent constant to within a 10 percent variation for the duration of the test.

(9) The time lag (interval between an event and the recording of the event on the strip chart or computer or integrator) shall be kept to a minimum. There shall be a clear association between the occurrence of an event and its being recorded.

(10) The sampling line tubing for the test chamber atmosphere and for the respirator sampling port shall be of equal diameter and of the same material. The length of the two lines shall be equal.

(11) The exhaust flow from the test chamber shall pass through an appropriate filter (i.e., high efficiency particulate filter) before release.

(12) When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50 percent.

(13) The limitations of instrument detection shall be taken into account when determining the fit factor.

(14) Test respirators shall be maintained in proper working order and be inspected regularly for deficiencies such as cracks or missing valves and gaskets.

### **(b) Procedural Requirements.**

(1) When performing the initial user seal check using a positive or negative pressure check, the sampling line shall be crimped closed in order to avoid air pressure leakage during either of these pressure checks.

(2) The use of an abbreviated screening QLFT test is optional. Such a test may be utilized in order to quickly identify poor fitting respirators that passed the positive and/or negative pressure test and reduce the amount of QNFT time. The use of the CNC QNFT instrument in the count mode is another optional method to obtain a quick estimate of fit and eliminate poor fitting respirators before going on to perform a full QNFT.

(3) A reasonably stable test agent concentration shall be measured in the test chamber prior to testing. For canopy or shower curtain types of test units, the determination of the test agent's stability may be established after the test subject has entered the test environment.

(4) Immediately after the subject enters the test chamber, the test agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half mask or 1 percent for a full facepiece respirator.

(5) A stable test agent concentration shall be obtained prior to the actual start of testing.

(6) Respirator restraining straps shall not be over-tightened for testing. The straps shall be adjusted by the wearer without assistance from other persons to give a reasonably comfortable fit typical of normal use. The respirator shall not be adjusted once the fit test exercises begin.

(7) The test shall be terminated whenever any single peak penetration exceeds 5 percent for half masks and 1 percent for full facepiece respirators. The test subject shall be refitted and retested.

(8) Calculation of fit factors.

(i) The fit factor shall be determined for the quantitative fit test by taking the ratio of the average chamber concentration to the concentration measured inside the respirator for each test exercise except the grimace exercise.

(ii) The average test chamber concentration shall be calculated as the arithmetic average of the concentration measured before and after each test (i.e., 7 exercises) or the arithmetic average of the concentration measured before and after each exercise or the true average measured continuously during the respirator sample.

(iii) The concentration of the challenge agent inside the respirator shall be determined by one of the following methods:

(A) Average peak penetration method means the method of determining test agent penetration into the respirator utilizing a strip chart recorder, integrator, or computer. The agent penetration is determined by an average of the peak heights on the graph or by computer integration, for each exercise except the grimace exercise. Integrators or computers that calculate the actual test agent penetration into the respirator for each exercise will also be considered to meet the requirements of the average peak penetration method.

(B) Maximum peak penetration method means the method of determining test agent penetration in the respirator as determined by strip chart recordings of the test. The highest peak penetration for a given exercise is taken to be representative of average penetration into the respirator for that exercise.

(C) Integration by calculation of the area under the individual peak for each exercise except the grimace exercise. This includes computerized integration.

(D) The calculation of the overall fit factor using individual exercise fit factors involves first converting the exercise fit factors to penetration values, determining the average, and then converting that result back to a fit factor. This procedure is described in the following equation:

Overall Fit Factor =

Number of exercises

$$1/ff_1 + 1/ff_2 + 1/ff_3 + 1/ff_4 + 1/ff_5 + 1/ff_7 + 1/ff_8$$

Where ff1, ff2, ff3, etc. are the fit factors for exercises 1, 2, 3, etc.

(9) The test subject shall not be permitted to wear a half mask or quarter facepiece respirator unless a minimum fit factor of 100 is obtained, or a full facepiece respirator unless a minimum fit factor of 500 is obtained.

(10) Filters used for quantitative fit testing shall be replaced whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media.

### **3. Ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol.**

The ambient aerosol condensation nuclei counter (CNC) quantitative fit testing (Portacount TM ) protocol quantitatively fit tests respirators with the use of a probe. The probed respirator is only used for quantitative fit tests. A probed respirator has a special sampling device, installed on the respirator, that allows the probe to sample the air from inside the mask. A probed respirator is required for each make, style, model, and size that the employer uses and can be obtained from the respirator manufacturer or distributor. The CNC instrument manufacturer, TSI Inc., also provides probe attachments (TSI sampling adapters) that permit fit testing in an employee's own respirator. A minimum fit factor pass level of at least 100 is necessary for a half-mask respirator and a minimum fit factor pass level of at least 500 is required for a full facepiece negative pressure respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

**(a) Portacount Fit Test Requirements.**

(1) Check the respirator to make sure the sampling probe and line are properly attached to the facepiece and that the respirator is fitted with a particulate filter capable of preventing significant penetration by the ambient particles used for the fit test (e.g., NIOSH 42 CFR 84 series 100, series 99, or series 95 particulate filter) per manufacturer's instruction.

(2) Instruct the person to be tested to don the respirator for five minutes before the fit test starts. This purges the ambient particles trapped inside the respirator and permits the wearer to make certain the respirator is comfortable. This individual shall already have been trained on how to wear the respirator properly.

(3) Check the following conditions for the adequacy of the respirator fit: Chin properly placed; Adequate strap tension, not overly tightened; Fit across nose bridge; Respirator of proper size to span distance from nose to chin; Tendency of the respirator to slip; Self-observation in a mirror to evaluate fit and respirator position.

(4) Have the person wearing the respirator do a user seal check. If leakage is detected, determine the cause. If leakage is from a poorly fitting facepiece, try another size of the same model respirator, or another model of respirator.

(5) Follow the manufacturer's instructions for operating the Portacount and proceed with the test.

(6) The test subject shall be instructed to perform the exercises in section I. A. 14. of this appendix.

(7) After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.

**(b) Portacount Test Instrument.**

(1) The Portacount will automatically stop and calculate the overall fit factor for the entire set of exercises. The overall fit factor is what counts. The Pass or Fail message will indicate whether or not the test was successful. If the test was a Pass, the fit test is over.

(2) Since the pass or fail criterion of the Portacount is user programmable, the test operator shall ensure that the pass or fail criterion meet the requirements for minimum respirator performance in this Appendix.

(3) A record of the test needs to be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style, and size of respirator used; and date tested.

**4. Controlled negative pressure (CNP) quantitative fit testing protocol.**

The CNP protocol provides an alternative to aerosol fit test methods. The CNP fit test method technology is based on exhausting air from a temporarily sealed respirator facepiece to generate and then maintain a constant negative pressure inside the facepiece. The rate of air exhaust is controlled so that a constant negative pressure is maintained in the respirator during the fit test. The level of pressure is selected to replicate the mean inspiratory pressure that causes leakage into the respirator under normal use conditions. With pressure held constant, air flow out of the respirator is equal to air flow into the respirator. Therefore, measurement of the exhaust stream that is required to hold the pressure in the temporarily sealed respirator constant yields a direct measure of leakage air flow into the respirator. The CNP fit test method measures leak rates through the facepiece as a method for determining the facepiece fit for negative pressure respirators. The CNP instrument manufacturer Dynatech Nevada also provides attachments (sampling manifolds) that replace the filter cartridges to permit fit testing in an employee's own respirator. To perform the test, the test subject closes his or her mouth and holds his/her breath, after which an air pump removes air from the respirator facepiece at a pre-selected constant pressure. The facepiece fit is expressed as the leak rate through the facepiece, expressed as milliliters per minute. The quality and validity of the CNP fit tests are determined by the degree to which the in-mask pressure tracks the test pressure during the system measurement time of approximately five seconds. Instantaneous feedback in the form of a real-time pressure trace of the in-mask pressure is provided and used to determine test validity and quality. A minimum fit factor pass level of 100 is necessary for a half-mask respirator and a minimum fit factor of at least 500 is required for a full facepiece respirator. The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

**(a) CNP Fit Test Requirements.**

(1) The instrument shall have a non-adjustable test pressure of 15.0 mm water pressure.

(2) The CNP system defaults selected for test pressure shall be set at -- 15 mm of water (-0.58 inches of water) and the modeled inspiratory flow rate shall be 53.8 liters per minute for performing fit tests.

**(Note:** CNP systems have built-in capability to conduct fit testing that is specific to unique work rate, mask, and gender situations that might apply in a specific workplace. Use of system default values, which were selected to represent respirator wear with medium cartridge resistance at a low-moderate work rate, will allow inter-test comparison of the respirator fit.)

(3) The individual who conducts the CNP fit testing shall be thoroughly trained to perform the test.

(4) The respirator filter or cartridge needs to be replaced with the CNP test manifold. The inhalation valve downstream from the manifold either needs to be temporarily removed or propped open.

(5) The test subject shall be trained to hold his or her breath for at least 20 seconds.

(6) The test subject shall don the test respirator without any assistance from the individual who conducts the CNP fit test.

(7) The QNFT protocol shall be followed according to section I.C. 1. of this appendix with an exception for the CNP test exercises.

**(b) CNP Test Exercises.**

(1) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject needs to hold head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(2) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply for 1 minute, being careful not to hyperventilate. After the deep breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during test measurement.

(3) Turning head side to side. Standing in place, the subject shall slowly turn his or her head from side to side between the extreme positions on each side for 1 minute. The head shall be held at each extreme momentarily so the subject can inhale at each side. After the turning head side to side exercise, the subject needs to

hold head full left and hold his or her breath for 10 seconds during test measurement. Next, the subject needs to hold head full right and hold his or her breath for 10 seconds during test measurement.

(4) Moving head up and down. Standing in place, the subject shall slowly move his or her head up and down for 1 minute. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling). After the moving head up and down exercise, the subject shall hold his or her head full up and hold his or her breath for 10 seconds during test measurement. Next, the subject shall hold his or her head full down and hold his or her breath for 10 seconds during test measurement.

(5) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song for 1 minute. After the talking exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(6) Grimace. The test subject shall grimace by smiling or frowning for 15 seconds.

(7) Bending Over. The test subject shall bend at the waist as if he or she were to touch his or her toes for 1 minute. Jogging in place shall be substituted for this exercise in those test environments such as shroud-type QNFT units that prohibit bending at the waist. After the bending over exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(8) Normal Breathing. The test subject shall remove and re-don the respirator within a one-minute period. Then, in a normal standing position, without talking, the subject shall breathe normally for 1 minute. After the normal breathing exercise, the subject shall hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement. After the test exercises, the test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of a respirator shall be tried.

**(c) CNP Test Instrument.**

(1) The test instrument shall have an effective audio warning device when the test subject fails to hold his or her breath during the test. The test shall be terminated whenever the test subject failed to hold his or her breath. The test subject may be refitted and retested.

(2) A record of the test shall be kept on file, assuming the fit test was successful. The record must contain the test subject's name; overall fit factor; make, model, style and size of respirator used; and date tested.

**Part II. New Fit Test Protocols**

A. Any person may submit to OSHA an application for approval of a new fit test protocol. If the application meets the following criteria, OSHA will initiate a rulemaking proceeding under section 6(b)(7) of the OSH Act to determine whether to list the new protocol as an approved protocol in this Appendix A.

B. The application must include a detailed description of the proposed new fit test protocol. This application must be supported by either:

1. A test report prepared by an independent government research laboratory (e.g., Lawrence Livermore National Laboratory, Los Alamos National Laboratory, the National Institute for Standards and Technology) stating that the laboratory has tested the protocol and had found it to be accurate and reliable; or

2. An article that has been published in a peer-reviewed industrial hygiene journal describing the protocol and explaining how test data support the protocol's accuracy and reliability.

C. If OSHA determines that additional information is required before the Agency commences a rulemaking proceeding under this section, OSHA will so notify the applicant and afford the applicant the opportunity to submit the supplemental information. Initiation of a rulemaking proceeding will be deferred until OSHA has received and evaluated the supplemental information.

[63 FR 20098, April 23, 1998]

**Appendix B-1 to § 1910.134: User Seal Check Procedures (Mandatory)**

The individual who uses a tight-fitting respirator is to perform a user seal check to ensure that an adequate seal is achieved each time the respirator is put on. Either the positive and negative pressure checks listed in this appendix, or the respirator manufacturer's recommended user seal check method shall be used. User seal checks are not substitutes for qualitative or quantitative fit tests.

**I. Facepiece Positive and/or Negative Pressure Checks****A. Positive pressure check.**

Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

**B. Negative pressure check.**

Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly, and hold the breath for ten seconds. The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand. The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

**II. Manufacturer's Recommended User Seal Check Procedures**

The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures provided that the employer demonstrates that the manufacturer's procedures are equally effective.

[63 FR 1152, Jan. 8, 1998]

**Appendix B-2 to § 1910.134: Respirator Cleaning Procedures (Mandatory)**

These procedures are provided for employer use when cleaning respirators. They are general in nature, and the employer as an alternative may use the cleaning recommendations provided by the manufacturer of the respirators used by their employees, provided such procedures are as effective as those listed here in Appendix B- 2. Equivalent effectiveness simply means that the procedures used must accomplish the objectives set forth in Appendix B-2, i.e., must ensure that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user.

**I. Procedures for Cleaning Respirators**

A. Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure- demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.

B. Wash components in warm (43 deg. C [110 deg. F] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.

C. Rinse components thoroughly in clean, warm (43 deg. C [110 deg. F] maximum), preferably running water. Drain.

D. When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:

1. Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43 deg. C (110 deg. F); or,

2. Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43 deg. C (110 deg. F); or,

3. Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.

E. Rinse components thoroughly in clean, warm (43 deg. C [110 deg. F] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized.

Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

F. Components should be hand-dried with a clean lint-free cloth or air-dried.

G. Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.

H. Test the respirator to ensure that all components work properly.

[63 FR 1152, Jan. 8, 1998]

**Appendix C to Sec. 1910.134: OSHA Respirator Medical Evaluation Questionnaire (Mandatory)**

To the employer: Answers to questions in Section 1, and to question 9 in Section 2 of Part A, do not require a medical examination.

To the employee:

Can you read (circle one): Yes/No

Your employer must allow you to answer this questionnaire during normal working hours, or at a time and place that is convenient to you. To maintain your confidentiality, your employer or supervisor must not look at or review your answers, and your employer must tell you how to deliver or send this questionnaire to the health care professional who will review it.

**Part A. Section 1. (Mandatory)**

The following information must be provided by every employee who has been selected to use any type of respirator (please print).

1. Today's date: \_\_\_\_\_
2. Your name: \_\_\_\_\_
3. Your age (to nearest year): \_\_\_\_\_
4. Sex (circle one): Male/Female
5. Your height: \_\_\_\_\_ ft. \_\_\_\_\_ in.
6. Your weight: \_\_\_\_\_ lbs.
7. Your job title: \_\_\_\_\_
8. A phone number where you can be reached by the health care professional who reviews this questionnaire (include the Area Code):  
\_\_\_\_\_
9. The best time to phone you at this number:  
\_\_\_\_\_
10. Has your employer told you how to contact the health care professional who will review this questionnaire (circle one): Yes/No
11. Check the type of respirator you will use (you can check more than one category):
  - a. \_\_\_\_\_ N, R, or P disposable respirator (filter-mask, non- cartridge type only).
  - b. \_\_\_\_\_ Other type (for example, half- or full-facepiece type, powered-air purifying, supplied-air, self-contained breathing apparatus).
12. Have you worn a respirator (circle one): Yes/No  
  
If "yes," what type(s): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Part A. Section 2. (Mandatory)**

Questions 1 through 9 below must be answered by every employee who has been selected to use any type of respirator (please circle "yes" or "no").

1. Do you currently smoke tobacco, or have you smoked tobacco in the last month: Yes/No
2. Have you ever had any of the following conditions?
  - a. Seizures (fits): Yes/No
  - b. Diabetes (sugar disease): Yes/No
  - c. Allergic reactions that interfere with your breathing: Yes/No
  - d. Claustrophobia (fear of closed-in places): Yes/No
  - e. Trouble smelling odors: Yes/No
3. Have you ever had any of the following pulmonary or lung problems?
  - a. Asbestosis: Yes/No
  - b. Asthma: Yes/No
  - c. Chronic bronchitis: Yes/No
  - d. Emphysema: Yes/No
  - e. Pneumonia: Yes/No
  - f. Tuberculosis: Yes/No
  - g. Silicosis: Yes/No
  - h. Pneumothorax (collapsed lung): Yes/No
  - i. Lung cancer: Yes/No
  - j. Broken ribs: Yes/No
  - k. Any chest injuries or surgeries: Yes/No
  - l. Any other lung problem that you've been told about: Yes/No
4. Do you currently have any of the following symptoms of pulmonary or lung illness?
  - a. Shortness of breath: Yes/No
  - b. Shortness of breath when walking fast on level ground or walking up a slight hill or incline: Yes/No
  - c. Shortness of breath when walking with other people at an ordinary pace on level ground: Yes/No
  - d. Have to stop for breath when walking at your own pace on level ground: Yes/No
  - e. Shortness of breath when washing or dressing yourself: Yes/No
  - f. Shortness of breath that interferes with your job: Yes/No
  - g. Coughing that produces phlegm (thick sputum): Yes/No

- h. Coughing that wakes you early in the morning: Yes/No
  - i. Coughing that occurs mostly when you are lying down: Yes/No
  - j. Coughing up blood in the last month: Yes/No
  - k. Wheezing: Yes/No
  - l. Wheezing that interferes with your job: Yes/No
  - m. Chest pain when you breathe deeply: Yes/No
  - n. Any other symptoms that you think may be related to lung problems: Yes/No
5. Have you ever had any of the following cardiovascular or heart problems?
- a. Heart attack: Yes/No
  - b. Stroke: Yes/No
  - c. Angina: Yes/No
  - d. Heart failure: Yes/No
  - e. Swelling in your legs or feet (not caused by walking): Yes/No
  - f. Heart arrhythmia (heart beating irregularly): Yes/No
  - g. High blood pressure: Yes/No
  - h. Any other heart problem that you've been told about: Yes/No
6. Have you ever had any of the following cardiovascular or heart symptoms?
- a. Frequent pain or tightness in your chest: Yes/No
  - b. Pain or tightness in your chest during physical activity: Yes/No
  - c. Pain or tightness in your chest that interferes with your job: Yes/No
  - d. In the past two years, have you noticed your heart skipping or missing a beat: Yes/No
  - e. Heartburn or indigestion that is not related to eating: Yes/ No
  - f. Any other symptoms that you think may be related to heart or circulation problems: Yes/No
7. Do you currently take medication for any of the following problems?
- a. Breathing or lung problems: Yes/No
  - b. Heart trouble: Yes/No
  - c. Blood pressure: Yes/No
  - d. Seizures (fits): Yes/No
8. If you've used a respirator, have you ever had any of the following problems? (If you've never used a respirator, check the following space and go to question 9):
- a. Eye irritation: Yes/No
  - b. Skin allergies or rashes: Yes/No
  - c. Anxiety: Yes/No
  - d. General weakness or fatigue: Yes/No
  - e. Any other problem that interferes with your use of a respirator: Yes/No
9. Would you like to talk to the health care professional who will review this questionnaire about your answers to this questionnaire: Yes/No
- Questions 10 to 15 below must be answered by every employee who has been selected to use either a full-facepiece respirator or a self-contained breathing apparatus (SCBA). For employees who have been selected to use other types of respirators, answering these questions is voluntary.
10. Have you ever lost vision in either eye (temporarily or permanently): Yes/No
11. Do you currently have any of the following vision problems?
- a. Wear contact lenses: Yes/No
  - b. Wear glasses: Yes/No
  - c. Color blind: Yes/No
  - d. Any other eye or vision problem: Yes/No
12. Have you ever had an injury to your ears, including a broken ear drum: Yes/No
13. Do you currently have any of the following hearing problems?
- a. Difficulty hearing: Yes/No
  - b. Wear a hearing aid: Yes/No
  - c. Any other hearing or ear problem: Yes/No
14. Have you ever had a back injury: Yes/No
15. Do you currently have any of the following musculoskeletal problems?
- a. Weakness in any of your arms, hands, legs, or feet: Yes/No
  - b. Back pain: Yes/No
  - c. Difficulty fully moving your arms and legs: Yes/No
  - d. Pain or stiffness when you lean forward or backward at the waist: Yes/No
  - e. Difficulty fully moving your head up or down: Yes/No
  - f. Difficulty fully moving your head side to side: Yes/No

- g. Difficulty bending at your knees: Yes/No
- h. Difficulty squatting to the ground: Yes/No
- i. Climbing a flight of stairs or a ladder carrying more than 25 lbs: Yes/No
- j. Any other muscle or skeletal problem that interferes with using a respirator: Yes/No

### Part B

Any of the following questions, and other questions not listed, may be added to the questionnaire at the discretion of the health care professional who will review the questionnaire.

1. In your present job, are you working at high altitudes (over 5,000 feet) or in a place that has lower than normal amounts of oxygen: Yes/No  
If "yes," do you have feelings of dizziness, shortness of breath, pounding in your chest, or other symptoms when you're working under these conditions: Yes/No
2. At work or at home, have you ever been exposed to hazardous solvents, hazardous airborne chemicals (e.g., gases, fumes, or dust), or have you come into skin contact with hazardous chemicals: Yes/No  
If "yes," name the chemicals if you know them: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. Have you ever worked with any of the materials, or under any of the conditions, listed below:
  - a. Asbestos: Yes/No
  - b. Silica (e.g., in sandblasting): Yes/No
  - c. Tungsten/cobalt (e.g., grinding or welding this material): Yes/No
  - d. Beryllium: Yes/No
  - e. Aluminum: Yes/No
  - f. Coal (for example, mining): Yes/No
  - g. Iron: Yes/No
  - h. Tin: Yes/No
  - i. Dusty environments: Yes/No
  - j. Any other hazardous exposures: Yes/No
 If "yes," describe these exposures: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
4. List any second jobs or side businesses you have: \_\_\_\_\_  
\_\_\_\_\_
5. List your previous occupations: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
6. List your current and previous hobbies: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
7. Have you been in the military services? Yes/No  
If "yes," were you exposed to biological or chemical agents (either in training or combat): Yes/No
8. Have you ever worked on a HAZMAT team? Yes/No
9. Other than medications for breathing and lung problems, heart trouble, blood pressure, and seizures mentioned earlier in this questionnaire, are you taking any other medications for any reason (including over-the-counter medications): Yes/No  
If "yes," name the medications if you know them: \_\_\_\_\_
10. Will you be using any of the following items with your respirator(s)?
  - a. HEPA Filters: Yes/No
  - b. Canisters (for example, gas masks): Yes/No
  - c. Cartridges: Yes/No
11. How often are you expected to use the respirator(s) (circle "yes" or "no" for all answers that apply to you)?
  - a. Escape only (no rescue): Yes/No
  - b. Emergency rescue only: Yes/No
  - c. Less than 5 hours per week: Yes/No
  - d. Less than 2 hours per day: Yes/No
  - e. 2 to 4 hours per day: Yes/No
  - f. Over 4 hours per day: Yes/No
12. During the period you are using the respirator(s), is your work effort:
  - a. Light (less than 200 kcal per hour): Yes/No
 If "yes," how long does this period last during the average shift: \_\_\_\_\_ hrs. \_\_\_\_\_ mins.  
Examples of a light work effort are sitting while writing, typing, drafting, or performing

light assembly work; or standing while operating a drill press (1-3 lbs.) or controlling machines.

b. Moderate (200 to 350 kcal per hour): Yes/No  
If "yes," how long does this period last during the average shift: \_\_\_\_\_ hrs. \_\_\_\_\_ mins.

Examples of moderate work effort are sitting while nailing or filing; driving a truck or bus in urban traffic; standing while drilling, nailing, performing assembly work, or transferring a moderate load (about 35 lbs.) at trunk level; walking on a level surface about 2 mph or down a 5-degree grade about 3 mph; or pushing a wheelbarrow with a heavy load (about 100 lbs.) on a level surface.

c. Heavy (above 350 kcal per hour): Yes/No  
If "yes," how long does this period last during the average shift: \_\_\_\_\_ hrs. \_\_\_\_\_ mins.

Examples of heavy work are lifting a heavy load (about 50 lbs.) from the floor to your waist or shoulder; working on a loading dock; shoveling; standing while bricklaying or chipping castings; walking up an 8-degree grade about 2 mph; climbing stairs with a heavy load (about 50 lbs.).

13. Will you be wearing protective clothing and/or equipment (other than the respirator) when you're using your respirator: Yes/No  
If "yes," describe this protective clothing and/or equipment:

\_\_\_\_\_  
\_\_\_\_\_

14. Will you be working under hot conditions (temperature exceeding 77 deg. F): Yes/No

15. Will you be working under humid conditions: Yes/No

16. Describe the work you'll be doing while you're using your respirator(s):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

17. Describe any special or hazardous conditions you might encounter when you're using your respirator(s) (for example, confined spaces, life-threatening gases):

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

18. Provide the following information, if you know it, for each toxic substance that you'll be exposed to when you're using your respirator(s): Name of the first toxic substance: \_\_\_\_\_  
Estimated maximum exposure level per shift

Duration of exposure per shift: \_\_\_\_\_

Name of the second toxic substance: \_\_\_\_\_

Estimated maximum exposure level per shift: \_\_\_\_\_

Duration of exposure per shift: \_\_\_\_\_

Name of the third toxic substance: \_\_\_\_\_

Estimated maximum exposure level per shift: \_\_\_\_\_

Duration of exposure per shift: \_\_\_\_\_

The name of any other toxic substances that you'll be exposed to while using your respirator: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

19. Describe any special responsibilities you'll have while using your respirator(s) that may affect the safety and well-being of others (for example, rescue, security): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

[63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998]

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**Appendix D to Sec. 1910.134 (Mandatory)  
Information for Employees Using  
Respirators When Not Required Under the  
Standard**

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker.

Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your voluntary use, or if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

You should do the following:

1. Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning, and care, and warnings regarding the respirator's limitations.

2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.

3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.

4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

[63 FR 1152, Jan. 8, 1998; 63 FR 20098, April 23, 1998]



**SUBPART Z TOXIC AND HAZARDOUS SUBSTANCES****29 CFR 1910.1200 Hazard communication.****(a) Purpose.**

(1) The purpose of this section is to ensure that the hazards of all chemicals produced or imported are evaluated, and that information concerning their hazards is transmitted to employers and employees. This transmittal of information is to be accomplished by means of comprehensive hazard communication programs, which are to include container labeling and other forms of warning, material safety data sheets and employee training.

(2) This occupational safety and health standard is intended to address comprehensively the issue of evaluating the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees, and to preempt any legal requirements of a state, or political subdivision of a state, pertaining to this subject. Evaluating the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees, may include, for example, but is not limited to, provisions for: developing and maintaining a written hazard communication program for the workplace, including lists of hazardous chemicals present; labeling of containers of chemicals in the workplace, as well as of containers of chemicals being shipped to other workplaces; preparation and distribution of material safety data sheets to employees and downstream employers; and development and implementation of employee training programs regarding hazards of chemicals and protective measures. Under section 18 of the Act, no state or political subdivision of a state may adopt or enforce, through any court or agency, any requirement relating to the issue addressed by this Federal standard, except pursuant to a Federally-approved state plan.

**(b) Scope and application.**

(1) This section requires chemical manufacturers or importers to assess the hazards of chemicals which they produce or import, and all employers to provide information to their employees about

the hazardous chemicals to which they are exposed, by means of a hazard communication program, labels and other forms of warning, material safety data sheets, and information and training. In addition, this section requires distributors to transmit the required information to employers. (Employers who do not produce or import chemicals need only focus on those parts of this rule that deal with establishing a workplace program and communicating information to their workers. Appendix E of this section is a general guide for such employers to help them determine their compliance obligations under the rule.)

(2) This section applies to any chemical which is known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency.

(3) This section applies to laboratories only as follows:

(i) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

(ii) Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible during each workshift to laboratory employees when they are in their work areas;

(iii) Employers shall ensure that laboratory employees are provided information and training in accordance with paragraph (h) of this section, except for the location and availability of the written hazard communication program under paragraph (h)(2)(iii) of this section; and, (iv) Laboratory employers that ship hazardous chemicals are considered to be either a chemical manufacturer or a distributor under this rule, and thus must ensure that any containers of hazardous chemicals leaving the laboratory are labeled in accordance with paragraph (f)(1) of this section, and that a material safety data sheet is provided to distributors and other employers in accordance with paragraphs (g)(6) and (g)(7) of this section.

(4) In work operations where employees only handle chemicals in sealed containers which are not opened under normal conditions of use (such as are found in marine cargo handling, warehousing, or retail sales), this section applies to these operations only as follows:

(i) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

(ii) Employers shall maintain copies of any material safety data sheets that are received with incoming shipments of the sealed containers of hazardous chemicals, shall obtain a material safety data sheet as soon as possible for sealed containers of hazardous chemicals received without a material safety data sheet if an employee requests the material safety data sheet, and shall ensure that the material safety data sheets are readily accessible during each work shift to employees when they are in their work area(s); and,

(iii) Employers shall ensure that employees are provided with information and training in accordance with paragraph (h) of this section (except for the location and availability of the written hazard communication program under paragraph (h)(2)(iii) of this section), to the extent necessary to protect them in the event of a spill or leak of a hazardous chemical from a sealed container.

(5) This section does not require labeling of the following chemicals:

(i) Any pesticide as such term is defined in the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136 et seq.), when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Environmental Protection Agency;

(ii) Any chemical substance or mixture as such terms are defined in the Toxic Substances Control Act (15 U.S.C. 2601 et seq.), when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Environmental Protection Agency.

(iii) Any food, food additive, color additive, drug, cosmetic, or medical or veterinary device or product, including materials intended for use as ingredients in such products (e.g. flavors and fragrances), as such terms are defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.) or the Virus-Serum-Toxin Act of 1913 (21 U.S.C. 151 et seq.), and regulations issued under those Acts, when they are subject to the labeling requirements under those Acts by either the Food and Drug Administration or the Department of Agriculture;

(iv) Any distilled spirits (beverage alcohols), wine, or malt beverage intended for nonindustrial use, as such terms are defined in the Federal Alcohol Administration Act (27 U.S.C. 201 et seq.) and regulations issued under that Act, when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Bureau of Alcohol, Tobacco, and Firearms;

(v) Any consumer product or hazardous substance as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq.) and Federal Hazardous Substances Act (15 U.S.C. 1261 et seq.) respectively, when subject to a consumer product safety standard or labeling requirement of those Acts, or regulations issued under those Acts by the Consumer Product Safety Commission; and,

(vi) Agricultural or vegetable seed treated with pesticides and labeled in accordance with the Federal Seed Act (7 U.S.C. 1551 et seq.) and the labeling regulations issued under that Act by the Department of Agriculture.

(6) This section does not apply to: (i) Any hazardous waste as such term is defined by the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6901 et seq.), when subject to regulations issued under that Act by the Environmental Protection Agency;

(ii) Any hazardous substance as such term is defined by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 U.S.C. 9601 et seq.) when the hazardous substance is the focus of remedial or removal action being conducted under CERCLA in accordance with Environmental Protection Agency regulations;

(iii) Tobacco or tobacco products;

(iv) Wood or wood products, including lumber which will not be processed, where the chemical manufacturer or importer can establish that the only hazard they pose to employees is the potential for flammability or combustibility (wood or wood products which have been treated with a hazardous chemical covered by this standard, and wood which may be subsequently sawed or cut, generating dust, are not exempted);

(v) Articles (as that term is defined in paragraph (c) of this section);

(vi) Food or alcoholic beverages which are sold, used, or prepared in a retail establishment (such as a grocery store, restaurant, or drinking place), and foods intended for personal consumption by employees while in the workplace;

(vii) Any drug, as that term is defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.), when it is in solid, final form for direct administration to the patient (e.g., tablets or pills); drugs which are packaged by the chemical manufacturer for sale to consumers in a retail establishment (e.g., over-the-counter drugs); and

drugs intended for personal consumption by employees while in the workplace (e.g., first aid supplies);

(viii) Cosmetics which are packaged for sale to consumers in a retail establishment, and cosmetics intended for personal consumption by employees while in the workplace;

(ix) Any consumer product or hazardous substance, as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq.) and Federal Hazardous Substances Act (15 U.S.C. 1261 et seq.) respectively, where the employer can show that it is used in the workplace for the purpose intended by the chemical manufacturer or importer of the product, and the use results in a duration and frequency of exposure which is not greater than the range of exposures that could reasonably be experienced by consumers when used for the purpose intended;

(x) Nuisance particulates where the chemical manufacturer or importer can establish that they do not pose any physical or health hazard covered under this section;

(xi) Ionizing and nonionizing radiation; and,

(xii) Biological hazards.

### (c) Definitions.

**Article** means a manufactured item other than a fluid or particle:

(i) which is formed to a specific shape or design during manufacture;

(ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and

(iii) which under normal conditions of use does not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical (as determined under paragraph (d) of this section), and does not pose a physical hazard or health risk to employees.

**Assistant Secretary** means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

**Chemical** means any element, chemical compound or mixture of elements and/or compounds.

**Chemical manufacturer** means an employer with a workplace where chemical(s) are produced for use or distribution.

**Chemical name** means the scientific designation of a chemical in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry

(IUPAC) or the Chemical Abstracts Service (CAS) rules of nomenclature, or a name which will clearly identify the chemical for the purpose of conducting a hazard evaluation.

**Combustible liquid** means any liquid having a flashpoint at or above 100 deg.F (37.8 deg.C), but below 200 deg.F (93.3 deg.C), except any mixture having components with flashpoints of 200 deg.F (93.3 deg.C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

**Commercial account** means an arrangement whereby a retail distributor sells hazardous chemicals to an employer, generally in large quantities over time and/or at costs that are below the regular retail price.

**Common name** means any designation or identification such as code name, code number, trade name, brand name or generic name used to identify a chemical other than by its chemical name.

**Compressed gas** means:

(i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 deg.F (21.1 deg.C); or

(ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 deg.F (54.4 deg.C) regardless of the pressure at 70 deg.F (21.1 deg.C); or

(iii) A liquid having a vapor pressure exceeding 40 psi at 100 deg.F (37.8 deg.C) as determined by ASTM D-323-72.

**Container** means any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank, or the like that contains a hazardous chemical. For purposes of this section, pipes or piping systems, and engines, fuel tanks, or other operating systems in a vehicle, are not considered to be containers.

**Designated representative** means any individual or organization to whom an employee gives written authorization to exercise such employee's rights under this section. A recognized or certified collective bargaining agent shall be treated automatically as a designated representative without regard to written employee authorization.

**Director** means the Director, National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, or designee.

**Distributor** means a business, other than a chemical manufacturer or importer, which supplies hazardous chemicals to other distributors or to employers.

**Employee** means a worker who may be exposed to hazardous chemicals under normal operating conditions or in foreseeable emergencies. Workers such as office workers or bank tellers who encounter hazardous chemicals only in nonroutine, isolated instances are not covered.

**Employer** means a person engaged in a business where chemicals are either used, distributed, or are produced for use or distribution, including a contractor or subcontractor.

**Explosive** means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

**Exposure or exposed** means that an employee is subjected in the course of employment to a chemical that is a physical or health hazard, and includes potential (e.g. accidental or possible) exposure. "Subjected" in terms of health hazards includes any route of entry (e.g. inhalation, ingestion, skin contact or absorption.)

**Flammable** means a chemical that falls into one of the following categories:

(i) **Aerosol, flammable** means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

(ii) **Gas, flammable** means: (A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of thirteen (13) percent by volume or less; or

(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than twelve (12) percent by volume, regardless of the lower limit;

(iii) **Liquid, flammable** means any liquid having a flashpoint below 100 deg.F (37.8 deg.C), except any mixture having components with flashpoints of 100 deg.F (37.8 deg.C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

(iv) **Solid, flammable** means a solid, other than a blasting agent or explosive as defined in Sec. 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a

flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

**Flashpoint** means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(i) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24-1979 (ASTM D 56-79)) for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 deg.F (37.8 deg.C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or

(ii) Pensky-Martens Closed Tester (see American National Standard Method of Test for Flash Point by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D 93-79)) for liquids with a viscosity equal to or greater than 45 SUS at 100 deg.F (37.8 deg.C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(iii) Setaflash Closed Tester (see American National Standard Method of Test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)). Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

**Foreseeable emergency** means any potential occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which could result in an uncontrolled release of a hazardous chemical into the workplace.

**Hazardous chemical** means any chemical which is a physical hazard or a health hazard.

**Hazard warning** means any words, pictures, symbols, or combination thereof appearing on a label or other appropriate form of warning which convey the specific physical and health hazard(s), including target organ effects, of the chemical(s) in the container(s). (See the definitions for "physical hazard" and "health hazard" to determine the hazards which must be covered.)

**Health hazard** means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes

chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. Appendix A provides further definitions and explanations of the scope of health hazards covered by this section, and Appendix B describes the criteria to be used to determine whether or not a chemical is to be considered hazardous for purposes of this standard.

**Identity** means any chemical or common name which is indicated on the material safety data sheet (MSDS) for the chemical. The identity used shall permit cross-references to be made among the required list of hazardous chemicals, the label and the MSDS.

**Immediate use** means that the hazardous chemical will be under the control of and used only by the person who transfers it from a labeled container and only within the work shift in which it is transferred.

**Importer** means the first business with employees within the Customs Territory of the United States which receives hazardous chemicals produced in other countries for the purpose of supplying them to distributors or employers within the United States.

**Label** means any written, printed, or graphic material displayed on or affixed to containers of hazardous chemicals.

**Material safety data sheet (MSDS)** means written or printed material concerning a hazardous chemical which is prepared in accordance with paragraph (g) of this section.

**Mixture** means any combination of two or more chemicals if the combination is not, in whole or in part, the result of a chemical reaction.

**Organic peroxide** means an organic compound that contains the bivalent -O-O-structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

**Oxidizer** means a chemical other than a blasting agent or explosive as defined in Sec. 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

**Physical hazard** means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive,

flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

**Produce** means to manufacture, process, formulate, blend, extract, generate, emit, or repackage. Pyrophoric means a chemical that will ignite spontaneously in air at a temperature of 130 deg.F (54.4 deg.C) or below.

**Responsible party** means someone who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

**Specific chemical identity** means the chemical name, Chemical Abstracts Service (CAS) Registry Number, or any other information that reveals the precise chemical designation of the substance.

**Trade secret** means any confidential formula, pattern, process, device, information or compilation of information that is used in an employer's business, and that gives the employer an opportunity to obtain an advantage over competitors who do not know or use it. Appendix D sets out the criteria to be used in evaluating trade secrets.

**Unstable (reactive)** means a chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

**Use** means to package, handle, react, emit, extract, generate as a byproduct, or transfer.

**Water-reactive** means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

**Work area** means a room or defined space in a workplace where hazardous chemicals are produced or used, and where employees are present.

**Workplace** means an establishment, job site, or project, at one geographical location containing one or more work areas.

#### (d) Hazard determination.

(1) Chemical manufacturers and importers shall evaluate chemicals produced in their workplaces or imported by them to determine if they are hazardous. Employers are not required to evaluate chemicals unless they choose not to rely on the evaluation performed by the chemical manufacturer or importer for the chemical to satisfy this requirement.

(2) Chemical manufacturers, importers or employers evaluating chemicals shall identify and consider the available scientific evidence concerning such hazards. For health hazards, evidence which is statistically significant and which is based on at least one positive study conducted in accordance with established scientific principles is considered to be sufficient to establish a hazardous effect if the results of the study meet the definitions of health hazards in this section. Appendix A shall be consulted for the scope of health hazards covered, and Appendix B shall be consulted for the criteria to be followed with respect to the completeness of the evaluation, and the data to be reported.

(3) The chemical manufacturer, importer or employer evaluating chemicals shall treat the following sources as establishing that the chemicals listed in them are hazardous:

(i) 29 CFR part 1910, subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA); or,

(ii) Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment, American Conference of Governmental Industrial Hygienists (ACGIH) (latest edition). The chemical manufacturer, importer, or employer is still responsible for evaluating the hazards associated with the chemicals in these source lists in accordance with the requirements of this standard.

(4) Chemical manufacturers, importers and employers evaluating chemicals shall treat the following sources as establishing that a chemical is a carcinogen or potential carcinogen for hazard communication purposes:

(i) National Toxicology Program (NTP), Annual Report on Carcinogens (latest edition);

(ii) International Agency for Research on Cancer (IARC) Monographs (latest editions); or

(iii) 29 CFR part 1910, subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration.

Note: The Registry of Toxic Effects of Chemical Substances published by the National Institute for Occupational Safety and Health indicates whether a chemical has been found by NTP or IARC to be a potential carcinogen.

(5) The chemical manufacturer, importer or employer shall determine the hazards of mixtures of chemicals as follows:

(i) If a mixture has been tested as a whole to determine its hazards, the results of such testing shall be used to determine whether the mixture is hazardous;

(ii) If a mixture has not been tested as a whole to determine whether the mixture is a health hazard, the mixture shall be assumed to present the same health hazards as do the components which comprise one percent (by weight or volume) or greater of the mixture, except that the mixture shall be assumed to present a carcinogenic hazard if it contains a component in concentrations of 0.1 percent or greater which is considered to be a carcinogen under paragraph (d)(4) of this section;

(iii) If a mixture has not been tested as a whole to determine whether the mixture is a physical hazard, the chemical manufacturer, importer, or employer may use whatever scientifically valid data is available to evaluate the physical hazard potential of the mixture; and,

(iv) If the chemical manufacturer, importer, or employer has evidence to indicate that a component present in the mixture in concentrations of less than one percent (or in the case of carcinogens, less than 0.1 percent) could be released in concentrations which would exceed an established OSHA permissible exposure limit or ACGIH Threshold Limit Value, or could present a health risk to employees in those concentrations, the mixture shall be assumed to present the same hazard.

(6) Chemical manufacturers, importers, or employers evaluating chemicals shall describe in writing the procedures they use to determine the hazards of the chemical they evaluate. The written procedures are to be made available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director. The written description may be incorporated into the written hazard communication program required under paragraph (e) of this section.

#### **(e) Written hazard communication program.**

(1) Employers shall develop, implement, and maintain at each workplace, a written hazard communication program which at least describes how the criteria specified in paragraphs (f), (g), and (h) of this section for labels and other forms of warning, material safety data sheets, and employee information and training will be met, and which also includes the following:

(i) A list of the hazardous chemicals known to be present using an identity that is referenced on the appropriate material safety data sheet (the

list may be compiled for the workplace as a whole or for individual work areas); and,

(ii) The methods the employer will use to inform employees of the hazards of nonroutine tasks (for example, the cleaning of reactor vessels), and the hazards associated with chemicals contained in unlabeled pipes in their work areas.

(2) Multiemployer workplaces. Employers who produce, use, or store hazardous chemicals at a workplace in such a way that the employees of other employer(s) may be exposed (for example, employees of a construction contractor working on-site) shall additionally ensure that the hazard communication programs developed and implemented under this paragraph (e) include the following:

(i) The methods the employer will use to provide the other employer(s) on-site access to material safety data sheets for each hazardous chemical the other employer(s)' employees may be exposed to while working;

(ii) The methods the employer will use to inform the other employer(s) of any precautionary measures that need to be taken to protect employees during the workplace's normal operating conditions and in foreseeable emergencies; and,

(iii) The methods the employer will use to inform the other employer(s) of the labeling system used in the workplace.

(3) The employer may rely on an existing hazard communication program to comply with these requirements, provided that it meets the criteria established in this paragraph (e).

(4) The employer shall make the written hazard communication program available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director, in accordance with the requirements of 29 CFR 1910.20 (e).

(5) Where employees must travel between workplaces during a workshift, i.e., their work is carried out at more than one geographical location, the written hazard communication program may be kept at the primary workplace facility.

#### **(f) Labels and other forms of warning.**

(1) The chemical manufacturer, importer, or distributor shall ensure that each container of hazardous chemicals leaving the workplace is

labeled, tagged or marked with the following information:

(i) Identity of the hazardous chemical(s);

(ii) Appropriate hazard warnings; and

(iii) Name and address of the chemical manufacturer, importer, or other responsible party.

(2)(i) For solid metal (such as a steel beam or a metal casting), solid wood, or plastic items that are not exempted as articles due to their downstream use, or shipments of whole grain, the required label may be transmitted to the customer at the time of the initial shipment, and need not be included with subsequent shipments to the same employer unless the information on the label changes;

(ii) The label may be transmitted with the initial shipment itself, or with the material safety data sheet that is to be provided prior to or at the time of the first shipment; and,

(iii) This exception to requiring labels on every container of hazardous chemicals is only for the solid material itself, and does not apply to hazardous chemicals used in conjunction with, or known to be present with, the material and to which employees handling the items in transit may be exposed (for example, cutting fluids or pesticides in grains).

(3) Chemical manufacturers, importers, or distributors shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged, or marked in accordance with this section in a manner which does not conflict with the requirements of the Hazardous Materials Transportation Act (49 U.S.C. 1801 et seq.) and regulations issued under that Act by the Department of Transportation.

(4) If the hazardous chemical is regulated by OSHA in a substance-specific health standard, the chemical manufacturer, importer, distributor or employer shall ensure that the labels or other forms of warning used are in accordance with the requirements of that standard.

(5) Except as provided in paragraphs (f)(6) and (f)(7) of this section, the employer shall ensure that each container of hazardous chemicals in the workplace is labeled, tagged or marked with the following information:

(i) Identity of the hazardous chemical(s) contained therein; and,

(ii) Appropriate hazard warnings, or alternatively, words, pictures, symbols, or combination thereof, which provide at least

general information regarding the hazards of the chemicals, and which, in conjunction with the other information immediately available to employees under the hazard communication program, will provide employees with the specific information regarding the physical and health hazards of the hazardous chemical.

(6) The employer may use signs, placards, process sheets, batch tickets, operating procedures, or other such written materials in lieu of affixing labels to individual stationary process containers, as long as the alternative method identifies the containers to which it is applicable and conveys the information required by paragraph (f)(5) of this section to be on a label. The written materials shall be readily accessible to the employees in their work area throughout each work shift.

(7) The employer is not required to label portable containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for the immediate use of the employee who performs the transfer. For purposes of this section, drugs which are dispensed by a pharmacy to a health care provider for direct administration to a patient are exempted from labeling.

(8) The employer shall not remove or deface existing labels on incoming containers of hazardous chemicals, unless the container is immediately marked with the required information.

(9) The employer shall ensure that labels or other forms of warning are legible, in English, and prominently displayed on the container, or readily available in the work area throughout each work shift. Employers having employees who speak other languages may add the information in their language to the material presented, as long as the information is presented in English as well.

(10) The chemical manufacturer, importer, distributor or employer need not affix new labels to comply with this section if existing labels already convey the required information.

(11) Chemical manufacturers, importers, distributors, or employers who become newly aware of any significant information regarding the hazards of a chemical shall revise the labels for the chemical within three months of becoming aware of the new information. Labels on containers of hazardous chemicals shipped after that time shall contain the new information. If the chemical is not currently produced or imported, the chemical manufacturer, importers, distributor, or employer shall add the information to the label before the chemical is shipped or introduced into the workplace again.

#### **(g) Material safety data sheets.**

(1) Chemical manufacturers and importers shall obtain or develop a material safety data sheet for each hazardous chemical they produce or import. Employers shall have a material safety data sheet in the workplace for each hazardous chemical which they use.

(2) Each material safety data sheet shall be in English (although the employer may maintain copies in other languages as well), and shall contain at least the following information:

(i) The identity used on the label, and, except as provided for in paragraph (i) of this section on trade secrets:

(A) If the hazardous chemical is a single substance, its chemical and common name(s);

(B) If the hazardous chemical is a mixture which has been tested as a whole to determine its hazards, the chemical and common name(s) of the ingredients which contribute to these known hazards, and the common name(s) of the mixture itself; or,

(C) If the hazardous chemical is a mixture which has not been tested as a whole:

(1) The chemical and common name(s) of all ingredients which have been determined to be health hazards, and which comprise 1% or greater of the composition, except that chemicals identified as carcinogens under paragraph (d) of this section shall be listed if the concentrations are 0.1% or greater; and,

(2) The chemical and common name(s) of all ingredients which have been determined to be health hazards, and which comprise less than 1% (0.1% for carcinogens) of the mixture, if there is evidence that the ingredient(s) could be released from the mixture in concentrations which would exceed an established OSHA permissible exposure limit or ACGIH Threshold Limit Value, or could present a health risk to employees; and,

(3) The chemical and common name(s) of all ingredients that have been determined to present a physical hazard when present in the mixture;

(ii) Physical and chemical characteristics of the hazardous chemical (such as vapor pressure, flash point);

(iii) The physical hazards of the hazardous chemical, including the potential for fire, explosion, and reactivity;

(iv) The health hazards of the hazardous chemical, including signs and symptoms of exposure, and any medical conditions which are

generally recognized as being aggravated by exposure to the chemical;

(v) The primary route(s) of entry;

(vi) The OSHA permissible exposure limit, ACGIH Threshold Limit Value, and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the material safety data sheet, where available;

(vii) Whether the hazardous chemical is listed in the National Toxicology Program (NTP) Annual Report on Carcinogens (latest edition) or has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest editions), or by OSHA;

(viii) Any generally applicable precautions for safe handling and use which are known to the chemical manufacturer, importer or employer preparing the material safety data sheet, including appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for cleanup of spills and leaks;

(ix) Any generally applicable control measures which are known to the chemical manufacturer, importer or employer preparing the material safety data sheet, such as appropriate engineering controls, work practices, or personal protective equipment;

(x) Emergency and first aid procedures;

(xi) The date of preparation of the material safety data sheet or the last change to it; and,

(xii) The name, address and telephone number of the chemical manufacturer, importer, employer or other responsible party preparing or distributing the material safety data sheet, who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

(3) If no relevant information is found for any given category on the material safety data sheet, the chemical manufacturer, importer or employer preparing the material safety data sheet shall mark it to indicate that no applicable information was found.

(4) Where complex mixtures have similar hazards and contents (i.e. the chemical ingredients are essentially the same, but the specific composition varies from mixture to mixture), the chemical manufacturer, importer or employer may prepare one material safety data sheet to apply to all of these similar mixtures.

(5) The chemical manufacturer, importer or employer preparing the material safety data sheet shall ensure that the information recorded

accurately reflects the scientific evidence used in making the hazard determination. If the chemical manufacturer, importer or employer preparing the material safety data sheet becomes newly aware of any significant information regarding the hazards of a chemical, or ways to protect against the hazards, this new information shall be added to the material safety data sheet within three months. If the chemical is not currently being produced or imported the chemical manufacturer or importer shall add the information to the material safety data sheet before the chemical is introduced into the workplace again.

(6)(i) Chemical manufacturers or importers shall ensure that distributors and employers are provided an appropriate material safety data sheet with their initial shipment, and with the first shipment after a material safety data sheet is updated;

(ii) The chemical manufacturer or importer shall either provide material safety data sheets with the shipped containers or send them to the distributor or employer prior to or at the time of the shipment;

(iii) If the material safety data sheet is not provided with a shipment that has been labeled as a hazardous chemical, the distributor or employer shall obtain one from the chemical manufacturer or importer as soon as possible; and,

(iv) The chemical manufacturer or importer shall also provide distributors or employers with a material safety data sheet upon request.

(7)(i) Distributors shall ensure that material safety data sheets, and updated information, are provided to other distributors and employers with their initial shipment and with the first shipment after a material safety data sheet is updated;

(ii) The distributor shall either provide material safety data sheets with the shipped containers, or send them to the other distributor or employer prior to or at the time of the shipment;

(iii) Retail distributors selling hazardous chemicals to employers having a commercial account shall provide a material safety data sheet to such employers upon request, and shall post a sign or otherwise inform them that a material safety data sheet is available;

(iv) Wholesale distributors selling hazardous chemicals to employers over-the-counter may also provide material safety data sheets upon the request of the employer at the time of the over-the-counter purchase, and shall post a sign or

otherwise inform such employers that a material safety data sheet is available;

(v) If an employer without a commercial account purchases a hazardous chemical from a retail distributor not required to have material safety data sheets on file (i.e., the retail distributor does not have commercial accounts and does not use the materials), the retail distributor shall provide the employer, upon request, with the name, address, and telephone number of the chemical manufacturer, importer, or distributor from which a material safety data sheet can be obtained;

(vi) Wholesale distributors shall also provide material safety data sheets to employers or other distributors upon request; and,

(vii) Chemical manufacturers, importers, and distributors need not provide material safety data sheets to retail distributors that have informed them that the retail distributor does not sell the product to commercial accounts or open the sealed container to use it in their own workplaces.

(8) The employer shall maintain in the workplace copies of the required material safety data sheets for each hazardous chemical, and shall ensure that they are readily accessible during each work shift to employees when they are in their work area(s). (Electronic access, microfiche, and other alternatives to maintaining paper copies of the material safety data sheets are permitted as long as no barriers to immediate employee access in each workplace are created by such options.)

(9) Where employees must travel between workplaces during a workshift, i.e., their work is carried out at more than one geographical location, the material safety data sheets may be kept at the primary workplace facility. In this situation, the employer shall ensure that employees can immediately obtain the required information in an emergency.

(10) Material safety data sheets may be kept in any form, including operating procedures, and may be designed to cover groups of hazardous chemicals in a work area where it may be more appropriate to address the hazards of a process rather than individual hazardous chemicals. However, the employer shall ensure that in all cases the required information is provided for each hazardous chemical, and is readily accessible during each work shift to employees when they are in their work area(s).

(11) Material safety data sheets shall also be made readily available, upon request, to

designated representatives and to the Assistant Secretary, in accordance with the requirements of 29 CFR 1910.20(e). The Director shall also be given access to material safety data sheets in the same manner.

#### **(h) Employee information and training.**

(1) Employers shall provide employees with effective information and training on hazardous chemicals in their work area at the time of their initial assignment, and whenever a new physical or health hazard the employees have not previously been trained about is introduced into their work area. Information and training may be designed to cover categories of hazards (e.g., flammability, carcinogenicity) or specific chemicals. Chemical-specific information must always be available through labels and material safety data sheets.

(2) Information. Employees shall be informed of:

(i) The requirements of this section;

(ii) Any operations in their work area where hazardous chemicals are present; and,

(iii) The location and availability of the written hazard communication program, including the required list(s) of hazardous chemicals, and material safety data sheets required by this section.

(3) Training. Employee training shall include at least:

(i) Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

(ii) The physical and health hazards of the chemicals in the work area;

(iii) The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and,

(iv) The details of the hazard communication program developed by the employer, including an explanation of the labeling system and the material safety data sheet, and how employees can obtain and use the appropriate hazard information.

**(i) Trade secrets.**

(1) The chemical manufacturer, importer, or employer may withhold the specific chemical identity, including the chemical name and other specific identification of a hazardous chemical, from the material safety data sheet, provided that:

(i) The claim that the information withheld is a trade secret can be supported;

(ii) Information contained in the material safety data sheet concerning the properties and effects of the hazardous chemical is disclosed;

(iii) The material safety data sheet indicates that the specific chemical identity is being withheld as a trade secret; and,

(iv) The specific chemical identity is made available to health professionals, employees, and designated representatives in accordance with the applicable provisions of this paragraph.

(2) Where a treating physician or nurse determines that a medical emergency exists and the specific chemical identity of a hazardous chemical is necessary for emergency or first-aid treatment, the chemical manufacturer, importer, or employer shall immediately disclose the specific chemical identity of a trade secret chemical to that treating physician or nurse, regardless of the existence of a written statement of need or a confidentiality agreement. The chemical manufacturer, importer, or employer may require a written statement of need and confidentiality agreement, in accordance with the provisions of paragraphs (i) (3) and (4) of this section, as soon as circumstances permit.

(3) In nonemergency situations, a chemical manufacturer, importer, or employer shall, upon request, disclose a specific chemical identity, otherwise permitted to be withheld under paragraph (i)(1) of this section, to a health professional (i.e. physician, industrial hygienist, toxicologist, epidemiologist, or occupational health nurse) providing medical or other occupational health services to exposed employee(s), and to employees or designated representatives, if:

(i) The request is in writing;

(ii) The request describes with reasonable detail one or more of the following occupational health needs for the information:

(A) To assess the hazards of the chemicals to which employees will be exposed;

(B) To conduct or assess sampling of the workplace atmosphere to determine employee exposure levels;

(C) To conduct preassignment or periodic medical surveillance of exposed employees;

(D) To provide medical treatment to exposed employees;

(E) To select or assess appropriate personal protective equipment for exposed employees;

(F) To design or assess engineering controls or other protective measures for exposed employees; and,

(G) To conduct studies to determine the health effects of exposure.

(iii) The request explains in detail why the disclosure of the specific chemical identity is essential and that, in lieu thereof, the disclosure of the following information to the health professional, employee, or designated representative, would not satisfy the purposes described in paragraph (i)(3)(ii) of this section:

(A) The properties and effects of the chemical;

(B) Measures for controlling workers' exposure to the chemical;

(C) Methods of monitoring and analyzing worker exposure to the chemical; and,

(D) Methods of diagnosing and treating harmful exposures to the chemical;

(iv) The request includes a description of the procedures to be used to maintain the confidentiality of the disclosed information; and,

(v) The health professional, and the employer or contractor of the services of the health professional (i.e. downstream employer, labor organization, or individual employee), employee, or designated representative, agree in a written confidentiality agreement that the health professional, employee, or designated representative, will not use the trade secret information for any purpose other than the health need(s) asserted and agree not to release the information under any circumstances other than to OSHA, as provided in paragraph (i)(6) of this section, except as authorized by the terms of the agreement or by the chemical manufacturer, importer, or employer.

(4) The confidentiality agreement authorized by paragraph (i)(3)(iv) of this section:

(i) May restrict the use of the information to the health purposes indicated in the written statement of need;

(ii) May provide for appropriate legal remedies in the event of a breach of the agreement, including stipulation of a reasonable preestimate of likely damages; and,

(iii) May not include requirements for the posting of a penalty bond.

(5) Nothing in this standard is meant to preclude the parties from pursuing noncontractual remedies to the extent permitted by law.

(6) If the health professional, employee, or designated representative receiving the trade secret information decides that there is a need to disclose it to OSHA, the chemical manufacturer, importer, or employer who provided the information shall be informed by the health professional, employee, or designated representative prior to, or at the same time as, such disclosure.

(7) If the chemical manufacturer, importer, or employer denies a written request for disclosure of a specific chemical identity, the denial must:

(i) Be provided to the health professional, employee, or designated representative, within thirty days of the request;

(ii) Be in writing;

(iii) Include evidence to support the claim that the specific chemical identity is a trade secret;

(iv) State the specific reasons why the request is being denied; and,

(v) Explain in detail how alternative information may satisfy the specific medical or occupational health need without revealing the specific chemical identity.

(8) The health professional, employee, or designated representative whose request for information is denied under paragraph (i)(3) of this section may refer the request and the written denial of the request to OSHA for consideration.

(9) When a health professional, employee, or designated representative refers the denial to OSHA under paragraph (i)(8) of this section, OSHA shall consider the evidence to determine if:

(i) The chemical manufacturer, importer, or employer has supported the claim that the specific chemical identity is a trade secret;

(ii) The health professional, employee, or designated representative has supported the claim that there is a medical or occupational health need for the information; and,

(iii) The health professional, employee or designated representative has demonstrated adequate means to protect the confidentiality.

(10)(i) If OSHA determines that the specific chemical identity requested under paragraph (i)(3) of this section is not a bona fide trade secret, or that it is a trade secret, but the requesting health professional, employee, or designated representative has a legitimate medical or

occupational health need for the information, has executed a written confidentiality agreement, and has shown adequate means to protect the confidentiality of the information, the chemical manufacturer, importer, or employer will be subject to citation by OSHA.

(ii) If a chemical manufacturer, importer, or employer demonstrates to OSHA that the execution of a confidentiality agreement would not provide sufficient protection against the potential harm from the unauthorized disclosure of a trade secret specific chemical identity, the Assistant Secretary may issue such orders or impose such additional limitations or conditions upon the disclosure of the requested chemical information as may be appropriate to assure that the occupational health services are provided without an undue risk of harm to the chemical manufacturer, importer, or employer.

(11) If a citation for a failure to release specific chemical identity information is contested by the chemical manufacturer, importer, or employer, the matter will be adjudicated before the Occupational Safety and Health Review Commission in accordance with the Act's enforcement scheme and the applicable Commission rules of procedure. In accordance with the Commission rules, when a chemical manufacturer, importer, or employer continues to withhold the information during the contest, the Administrative Law Judge may review the citation and supporting documentation in camera or issue appropriate orders to protect the confidentiality of such matters.

(12) Notwithstanding the existence of a trade secret claim, a chemical manufacturer, importer, or employer shall, upon request, disclose to the Assistant Secretary any information which this section requires the chemical manufacturer, importer, or employer to make available. Where there is a trade secret claim, such claim shall be made no later than at the time the information is provided to the Assistant Secretary so that suitable determinations of trade secret status can be made and the necessary protections can be implemented.

(13) Nothing in this paragraph shall be construed as requiring the disclosure under any circumstances of process or percentage of mixture information which is a trade secret.

**(j) Effective dates.**

Chemical manufacturers, importers, distributors, and employers shall be in compliance with all provisions of this section by March 11, 1994.

Note: The effective date of the clarification that the exemption of wood and wood products from the Hazard Communication standard in paragraph (b)(6)(iv) only applies to wood and wood products including lumber which will not be processed, where the manufacturer or importer can establish that the only hazard they pose to employees is the potential for flammability or combustibility, and that the exemption does not apply to wood or wood products which have been treated with a hazardous chemical covered by this standard, and wood which may be subsequently sawed or cut generating dust has been stayed from March 11, 1994 to August 11, 1994.

**Appendix A to Sec. 1910.1200--Health Hazard Definitions (Mandatory)**

Although safety hazards related to the physical characteristics of a chemical can be objectively defined in terms of testing requirements (e.g. flammability), health hazard definitions are less precise and more subjective. Health hazards may cause measurable changes in the body, such as decreased pulmonary function. These changes are generally indicated by the occurrence of signs and symptoms in the exposed employees, such as shortness of breath, a nonmeasurable, subjective feeling. Employees exposed to such hazards must be apprised of both the change in body function and the signs and symptoms that may occur to signal that change.

The determination of occupational health hazards is complicated by the fact that many of the effects or signs and symptoms occur commonly in nonoccupationally exposed populations, so that effects of exposure are difficult to separate from normally occurring illnesses. Occasionally, a substance causes an effect that is rarely seen in the population at large, such as angiosarcomas caused by vinyl chloride exposure, thus making it easier to ascertain that the occupational exposure was the primary causative factor. More often, however, the effects are common, such as lung cancer. The situation is further complicated by the fact that most chemicals have not been adequately tested to determine their health hazard potential, and data do not exist to substantiate these effects.

There have been many attempts to categorize effects and to define them in various ways. Generally, the terms "acute" and "chronic" are used to delineate between effects on the basis of severity or duration. "Acute" effects usually occur rapidly as a result of short-term exposures, and are of short duration. "Chronic" effects generally occur as a result of long-term exposure, and are of long duration.

The acute effects referred to most frequently are those defined by the American National Standards Institute (ANSI) standard for Precautionary Labeling of Hazardous Industrial Chemicals (Z129.1-1988)--irritation, corrosivity, sensitization and lethal dose. Although these are important health effects, they do not adequately cover the considerable range of acute effects which may occur as a result of occupational exposure, such as, for example, narcosis.

Similarly, the term chronic effect is often used to cover only carcinogenicity, teratogenicity, and mutagenicity. These effects are obviously a concern in the workplace, but again, do not adequately cover the area of chronic effects, excluding, for example, blood dyscrasias (such as anemia), chronic bronchitis and liver atrophy.

The goal of defining precisely, in measurable terms, every possible health effect that may occur in the workplace as a result of chemical exposures cannot realistically be accomplished. This does not negate the need for employees to be informed of such effects and protected from them. Appendix B, which is also mandatory, outlines the principles and procedures of hazard assessment.

For purposes of this section, any chemicals which meet any of the following definitions, as determined by the criteria set forth in Appendix B are health hazards. However, this is not intended to be an exclusive categorization scheme. If there are available scientific data that involve other animal species or test methods, they must also be evaluated to determine the applicability of the HCS.<sup>7</sup>

1. Carcinogen: A chemical is considered to be a carcinogen if:

(a) It has been evaluated by the International Agency for Research on Cancer (IARC), and found to be a carcinogen or potential carcinogen; or

(b) It is listed as a carcinogen or potential carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or,

(c) It is regulated by OSHA as a carcinogen.

2. Corrosive: A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in appendix A to 49 CFR part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours. This term shall not refer to action on inanimate surfaces.

3. Highly toxic: A chemical falling within any of the following categories:

(a) A chemical that has a median lethal dose (LD<sub>50</sub>) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(b) A chemical that has a median lethal dose (LD<sub>50</sub>) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

(c) A chemical that has a median lethal concentration (LC<sub>50</sub>) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within 1 hour) to albino rats weighing between 200 and 300 grams each.

4. Irritant: A chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A chemical is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 CFR 1500.41 for four hours exposure or by other appropriate techniques, it results in an empirical score of five or more. A chemical is an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques.

5. Sensitizer: A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

6. Toxic. A chemical falling within any of the following categories:

(a) A chemical that has a median lethal dose (LD<sub>50</sub>) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered

orally to albino rats weighing between 200 and 300 grams each.

(b) A chemical that has a median lethal dose (LD<sub>50</sub>) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

(c) A chemical that has a median lethal concentration (LC<sub>50</sub>) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

7. Target organ effects.

The following is a target organ categorization of effects which may occur, including examples of signs and symptoms and chemicals which have been found to cause such effects. These examples are presented to illustrate the range and diversity of effects and hazards found in the workplace, and the broad scope employers must consider in this area, but are not intended to be all-inclusive.

a. Hepatotoxins: Chemicals that produce liver damage

Signs & Symptoms: Jaundice; liver enlargement

Chemicals: Carbon tetrachloride; nitrosamines

b. Nephrotoxins: Chemicals which produce kidney damage

Signs & Symptoms: Edema; proteinuria

Chemicals: Halogenated hydrocarbons; uranium

c. Neurotoxins: Chemicals which produce their primary toxic effects on the nervous system

Signs & Symptoms: Narcosis; behavioral changes; decrease in motor functions

Chemicals: Mercury; carbon disulfide

d. Agents which act on the blood or hematopoietic system: Decrease hemoglobin function; deprive the body tissues of oxygen

Signs & Symptoms: Cyanosis; loss of consciousness

Chemicals: Carbon monoxide; cyanides

e. Agents which damage the lung: Chemicals which irritate or damage pulmonary tissue

Signs & Symptoms: Cough; tightness in chest; shortness of breath

Chemicals: Silica; asbestos

f. Reproductive toxins: Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis)

Signs & Symptoms: Birth defects; sterility

Chemicals: Lead; DBCP

g. Cutaneous hazards: Chemicals which affect the dermal layer of the body

Signs & Symptoms: Defatting of the skin; rashes; irritation

Chemicals: Ketones; chlorinated compounds

h. Eye hazards: Chemicals that affect the eye or visual capacity

Signs & Symptoms: Conjunctivitis; corneal damage

Chemicals: Organic solvents; acids

### **Appendix B to Sec. 1910.1200--Hazard Determination (Mandatory)**

The quality of a hazard communication program is largely dependent upon the adequacy and accuracy of the hazard determination. The hazard determination requirement of this standard is performance-oriented. Chemical manufacturers, importers, and employers evaluating chemicals are not required to follow any specific methods for determining hazards, but they must be able to demonstrate that they have adequately ascertained the hazards of the chemicals produced or imported in accordance with the criteria set forth in this Appendix.

Hazard evaluation is a process which relies heavily on the professional judgment of the evaluator, particularly in the area of chronic hazards. The performance-orientation of the hazard determination does not diminish the duty of the chemical manufacturer, importer or employer to conduct a thorough evaluation, examining all relevant data and producing a scientifically defensible evaluation. For purposes of this standard, the following criteria shall be used in making hazard determinations that meet the requirements of this standard.

1. Carcinogenicity: As described in paragraph (d)(4) of this section and Appendix A of this section, a determination by the National Toxicology Program, the International Agency for Research on Cancer, or OSHA that a chemical is a carcinogen or potential carcinogen will be considered conclusive evidence for purposes of this section. In addition, however, all available scientific data on carcinogenicity must be

evaluated in accordance with the provisions of this Appendix and the requirements of the rule.

2. Human data: Where available, epidemiological studies and case reports of adverse health effects shall be considered in the evaluation.

3. Animal data: Human evidence of health effects in exposed populations is generally not available for the majority of chemicals produced or used in the workplace. Therefore, the available results of toxicological testing in animal populations shall be used to predict the health effects that may be experienced by exposed workers. In particular, the definitions of certain acute hazards refer to specific animal testing results (see Appendix A).

4. Adequacy and reporting of data. The results of any studies which are designed and conducted according to established scientific principles, and which report statistically significant conclusions regarding the health effects of a chemical, shall be a sufficient basis for a hazard determination and reported on any material safety data sheet. In vitro studies alone generally do not form the basis for a definitive finding of hazard under the HCS since they have a positive or negative result rather than a statistically significant finding.

The chemical manufacturer, importer, or employer may also report the results of other scientifically valid studies which tend to refute the findings of hazard.

### **Appendix C to Sec. 1910.1200 [Reserved]**

### **Appendix D to Sec. 1910.1200--Definition of "Trade Secret" (Mandatory)**

The following is a reprint of the Restatement of Torts section 757, comment b (1939):

b. Definition of trade secret. A trade secret may consist of any formula, pattern, device or compilation of information which is used in one's business, and which gives him an opportunity to obtain an advantage over competitors who do not know or use it. It may be a formula for a chemical compound, a process of manufacturing, treating or preserving materials, a pattern for a machine or other device, or a list of customers. It differs from other secret information in a business (see s759 of the Restatement of Torts which is not included in this Appendix) in that it is not simply information as to single or ephemeral events in the conduct of the business, as, for example, the amount or other terms of a secret bid for a contract or the salary of

certain employees, or the security investments made or contemplated, or the date fixed for the announcement of a new policy or for bringing out a new model or the like. A trade secret is a process or device for continuous use in the operations of the business. Generally it relates to the production of goods, as, for example, a machine or formula for the production of an article. It may, however, relate to the sale of goods or to other operations in the business, such as a code for determining discounts, rebates or other concessions in a price list or catalogue, or a list of specialized customers, or a method of bookkeeping or other office management.

**Secrecy.** The subject matter of a trade secret must be secret. Matters of public knowledge or of general knowledge in an industry cannot be appropriated by one as his secret. Matters which are completely disclosed by the goods which one markets cannot be his secret. Substantially, a trade secret is known only in the particular business in which it is used. It is not requisite that only the proprietor of the business know it. He may, without losing his protection, communicate it to employees involved in its use. He may likewise communicate it to others pledged to secrecy. Others may also know of it independently, as, for example, when they have discovered the process or formula by independent invention and are keeping it secret. Nevertheless, a substantial element of secrecy must exist, so that, except by the use of improper means, there would be difficulty in acquiring the information. An exact definition of a trade secret is not possible. Some factors to be considered in determining whether given information is one's trade secret are: (1) The extent to which the information is known outside of his business; (2) the extent to which it is known by employees and others involved in his business; (3) the extent of measures taken by him to guard the secrecy of the information; (4) the value of the information to him and his competitors; (5) the amount of effort or money expended by him in developing the information; (6) the ease or difficulty with which the information could be properly acquired or duplicated by others.

**Novelty and prior art.** A trade secret may be a device or process which is patentable; but it need not be that. It may be a device or process which is clearly anticipated in the prior art or one which is merely a mechanical improvement that a good mechanic can make. Novelty and invention are not requisite for a trade secret as they are for patentability. These requirements are essential to

patentability because a patent protects against unlicensed use of the patented device or process even by one who discovers it properly through independent research. The patent monopoly is a reward to the inventor. But such is not the case with a trade secret. Its protection is not based on a policy of rewarding or otherwise encouraging the development of secret processes or devices. The protection is merely against breach of faith and reprehensible means of learning another's secret. For this limited protection it is not appropriate to require also the kind of novelty and invention which is a requisite of patentability. The nature of the secret is, however, an important factor in determining the kind of relief that is appropriate against one who is subject to liability under the rule stated in this Section. Thus, if the secret consists of a device or process which is a novel invention, one who acquires the secret wrongfully is ordinarily enjoined from further use of it and is required to account for the profits derived from his past use. If, on the other hand, the secret consists of mechanical improvements that a good mechanic can make without resort to the secret, the wrongdoer's liability may be limited to damages, and an injunction against future use of the improvements made with the aid of the secret may be inappropriate.

## **Appendix E to Sec. 1910.1200--(Advisory)-- Guidelines for Employer**

### **Compliance**

The Hazard Communication Standard (HCS) is based on a simple concept--that employees have both a need and a right to know the hazards and identities of the chemicals they are exposed to when working. They also need to know what protective measures are available to prevent adverse effects from occurring. The HCS is designed to provide employees with the information they need.

Knowledge acquired under the HCS will help employers provide safer workplaces for their employees. When employers have information about the chemicals being used, they can take steps to reduce exposures, substitute less hazardous materials, and establish proper work practices. These efforts will help prevent the occurrence of work-related illnesses and injuries caused by chemicals.

The HCS addresses the issues of evaluating and communicating hazards to workers. Evaluation of chemical hazards involves a number

of technical concepts, and is a process that requires the professional judgment of experienced experts. That's why HCS is designed so that employers who simply use chemicals, rather than produce or import them, are not required to evaluate the hazards of those chemicals. Hazard determination is the responsibility of the producers and importers of the materials. Producers and importers of chemicals are then required to provide the hazard information to employers that purchase their products.

Employers that don't produce or import chemicals need only focus on those parts of the rule that deal with establishing a workplace program and communicating information to their workers. This appendix is a general guide for such employers to help them determine what's required under the rule. It does not supplant or substitute for the regulatory provisions, but rather provides a simplified outline of the steps an average employer would follow to meet those requirements.

### **1. Becoming Familiar With The Rule.**

OSHA has provided a simple summary of the HCS in a pamphlet entitled "Chemical Hazard Communication," OSHA Publication Number 3084. Some employers prefer to begin to become familiar with the rule's requirements by reading this pamphlet. A copy may be obtained from your local OSHA Area Office, or by contacting the OSHA Publications Office at (202) 523-9667.

The standard is long, and some parts of it are technical, but the basic concepts are simple. In fact, the requirements reflect what many employers have been doing for years. You may find that you are already largely in compliance with many of the provisions, and will simply have to modify your existing programs somewhat. If you are operating in an OSHA-approved State Plan State, you must comply with the State's requirements, which may be different than those of the Federal rule. Many of the State Plan States had hazard communication or "right-to-know" laws prior to promulgation of the Federal rule. Employers in State Plan States should contact their State OSHA offices for more information regarding applicable requirements.

The HCS requires information to be prepared and transmitted regarding all hazardous chemicals. The HCS covers both physical hazards (such as flammability), and health hazards (such as irritation, lung damage, and cancer). Most

chemicals used in the workplace have some hazard potential, and thus will be covered by the rule.

One difference between this rule and many others adopted by OSHA is that this one is performance-oriented. That means that you have the flexibility to adapt the rule to the needs of your workplace, rather than having to follow specific, rigid requirements. It also means that you have to exercise more judgment to implement an appropriate and effective program.

The standard's design is simple. Chemical manufacturers and importers must evaluate the hazards of the chemicals they produce or import. Using that information, they must then prepare labels for containers, and more detailed technical bulletins called material safety data sheets (MSDS).

Chemical manufacturers, importers, and distributors of hazardous chemicals are all required to provide the appropriate labels and material safety data sheets to the employers to which they ship the chemicals. The information is to be provided automatically. Every container of hazardous chemicals you receive must be labeled, tagged, or marked with the required information. Your suppliers must also send you a properly completed material safety data sheet (MSDS) at the time of the first shipment of the chemical, and with the next shipment after the MSDS is updated with new and significant information about the hazards.

You can rely on the information received from your suppliers. You have no independent duty to analyze the chemical or evaluate the hazards of it.

Employers that "use" hazardous chemicals must have a program to ensure the information is provided to exposed employees. "Use" means to package, handle, react, or transfer. This is an intentionally broad scope, and includes any situation where a chemical is present in such a way that employees may be exposed under normal conditions of use or in a foreseeable emergency.

The requirements of the rule that deal specifically with the hazard communication program are found in this section in paragraphs (e), written hazard communication program; (f), labels and other forms of warning; (g), material safety data sheets; and (h), employee information and training. The requirements of these paragraphs should be the focus of your attention.

Concentrate on becoming familiar with them, using paragraphs (b), scope and application, and (c), definitions, as references when needed to help explain the provisions.

There are two types of work operations where the coverage of the rule is limited. These are laboratories and operations where chemicals are only handled in sealed containers (e.g., a warehouse). The limited provisions for these workplaces can be found in paragraph (b) of this section, scope and application. Basically, employers having these types of work operations need only keep labels on containers as they are received; maintain material safety data sheets that are received, and give employees access to them; and provide information and training for employees. Employers do not have to have written hazard communication programs and lists of chemicals for these types of operations.

The limited coverage of laboratories and sealed container operations addresses the obligation of an employer to the workers in the operations involved, and does not affect the employer's duties as a distributor of chemicals. For example, a distributor may have warehouse operations where employees would be protected under the limited sealed container provisions. In this situation, requirements for obtaining and maintaining MSDSs are limited to providing access to those received with containers while the substance is in the workplace, and requesting MSDSs when employees request access for those not received with the containers. However, as a distributor of hazardous chemicals, that employer will still have responsibilities for providing MSDSs to downstream customers at the time of the first shipment and when the MSDS is updated. Therefore, although they may not be required for the employees in the work operation, the distributor may, nevertheless, have to have MSDSs to satisfy other requirements of the rule.

## **2. Identify Responsible Staff**

Hazard communication is going to be a continuing program in your facility. Compliance with the HCS is not a "one shot deal." In order to have a successful program, it will be necessary to assign responsibility for both the initial and ongoing activities that have to be undertaken to comply with the rule. In some cases, these activities may already be part of current job assignments. For example, site supervisors are frequently responsible for on-the-job training sessions. Early identification of the responsible employees, and involvement of them in the

development of your plan of action, will result in a more effective program design. Evaluation of the effectiveness of your program will also be enhanced by involvement of affected employees.

For any safety and health program, success depends on commitment at every level of the organization. This is particularly true for hazard communication, where success requires a change in behavior. This will only occur if employers understand the program, and are committed to its success, and if employees are motivated by the people presenting the information to them.

## **3. Identify Hazardous Chemicals in the Workplace.**

The standard requires a list of hazardous chemicals in the workplace as part of the written hazard communication program. The list will eventually serve as an inventory of everything for which an MSDS must be maintained. At this point, however, preparing the list will help you complete the rest of the program since it will give you some idea of the scope of the program required for compliance in your facility. The best way to prepare a comprehensive list is to survey the workplace. Purchasing records may also help, and certainly employers should establish procedures to ensure that in the future purchasing procedures result in MSDSs being received before a material is used in the workplace.

The broadest possible perspective should be taken when doing the survey. Sometimes people think of "chemicals" as being only liquids in containers. The HCS covers chemicals in all physical forms--liquids, solids, gases, vapors, fumes, and mists--whether they are "contained" or not. The hazardous nature of the chemical and the potential for exposure are the factors which determine whether a chemical is covered. If it's not hazardous, it's not covered. If there is no potential for exposure (e.g., the chemical is inextricably bound and cannot be released), the rule does not cover the chemical.

Look around. Identify chemicals in containers, including pipes, but also think about chemicals generated in the work operations. For example, welding fumes, dusts, and exhaust fumes are all sources of chemical exposures. Read labels provided by suppliers for hazard information. Make a list of all chemicals in the workplace that are potentially hazardous. For your own information and planning, you may also want to

note on the list the location(s) of the products within the workplace, and an indication of the hazards as found on the label. This will help you as you prepare the rest of your program.

Paragraph (b) of this section, scope and application, includes exemptions for various chemicals or workplace situations. After compiling the complete list of chemicals, you should review paragraph (b) of this section to determine if any of the items can be eliminated from the list because they are exempted materials. For example, food, drugs, and cosmetics brought into the workplace for employee consumption are exempt. So rubbing alcohol in the first aid kit would not be covered.

Once you have compiled as complete a list as possible of the potentially hazardous chemicals in the workplace, the next step is to determine if you have received material safety data sheets for all of them. Check your files against the inventory you have just compiled. If any are missing, contact your supplier and request one. It is a good idea to document these requests, either by copy of a letter or a note regarding telephone conversations. If you have MSDSs for chemicals that are not on your list, figure out why. Maybe you don't use the chemical anymore. Or maybe you missed it in your survey. Some suppliers do provide MSDSs for products that are not hazardous. These do not have to be maintained by you.

You should not allow employees to use any chemicals for which you have not received an MSDS. The MSDS provides information you need to ensure proper protective measures are implemented prior to exposure.

#### **4. Preparing and Implementing a Hazard Communication Program**

All workplaces where employees are exposed to hazardous chemicals must have a written plan which describes how the standard will be implemented in that facility. Preparation of a plan is not just a paper exercise--all of the elements must be implemented in the workplace in order to be in compliance with the rule. See paragraph (e) of this section for the specific requirements regarding written hazard communication programs. The only work operations which do not have to comply with the written plan requirements are laboratories and work operations where employees only handle chemicals in sealed containers. See paragraph (b)

of this section, scope and application, for the specific requirements for these two types of workplaces.

The plan does not have to be lengthy or complicated. It is intended to be a blueprint for implementation of your program--an assurance that all aspects of the requirements have been addressed.

Many trade associations and other professional groups have provided sample programs and other assistance materials to affected employers. These have been very helpful to many employers since they tend to be tailored to the particular industry involved. You may wish to investigate whether your industry trade groups have developed such materials.

Although such general guidance may be helpful, you must remember that the written program has to reflect what you are doing in your workplace. Therefore, if you use a generic program it must be adapted to address the facility it covers. For example, the written plan must list the chemicals present at the site, indicate who is to be responsible for the various aspects of the program in your facility, and indicate where written materials will be made available to employees.

If OSHA inspects your workplace for compliance with the HCS, the OSHA compliance officer will ask to see your written plan at the outset of the inspection. In general, the following items will be considered in evaluating your program.

The written program must describe how the requirements for labels and other forms of warning, material safety data sheets, and employee information and training, are going to be met in your facility. The following discussion provides the type of information compliance officers will be looking for to decide whether these elements of the hazard communication program have been properly addressed:

##### **A. Labels and Other Forms of Warning**

In-plant containers of hazardous chemicals must be labeled, tagged, or marked with the identity of the material and appropriate hazard warnings. Chemical manufacturers, importers, and distributors are required to ensure that every container of hazardous chemicals they ship is appropriately labeled with such information and with the name and address of the producer or other responsible party. Employers purchasing

chemicals can rely on the labels provided by their suppliers. If the material is subsequently transferred by the employer from a labeled container to another container, the employer will have to label that container unless it is subject to the portable container exemption. See paragraph (f) of this section for specific labeling requirements.

The primary information to be obtained from an OSHA-required label is an identity for the material, and appropriate hazard warnings. The identity is any term which appears on the label, the MSDS, and the list of chemicals, and thus links these three sources of information. The identity used by the supplier may be a common or trade name ("Black Magic Formula"), or a chemical name (1,1,1-trichloroethane). The hazard warning is a brief statement of the hazardous effects of the chemical ("flammable," "causes lung damage"). Labels frequently contain other information, such as precautionary measures ("do not use near open flame"), but this information is provided voluntarily and is not required by the rule. Labels must be legible, and prominently displayed. There are no specific requirements for size or color, or any specified text.

With these requirements in mind, the compliance officer will be looking for the following types of information to ensure that labeling will be properly implemented in your facility:

1. Designation of person(s) responsible for ensuring labeling of in-plant containers;
  2. Designation of person(s) responsible for ensuring labeling of any shipped containers;
  3. Description of labeling system(s) used;
  4. Description of written alternatives to labeling of in-plant containers (if used); and,
  5. Procedures to review and update label information when necessary.
- Employers that are purchasing and using hazardous chemicals--rather than producing or distributing them--will primarily be concerned with ensuring that every purchased container is labeled. If materials are transferred into other containers, the employer must ensure that these are labeled as well, unless they fall under the portable container exemption (paragraph (f)(7) of this section). In terms of labeling systems, you can simply choose to use the labels provided by your suppliers on the containers. These will generally be verbal text labels, and do not usually include numerical rating systems or symbols that require special training. The most important thing to remember

is that this is a continuing duty--all in-plant containers of hazardous chemicals must always be labeled. Therefore, it is important to designate someone to be responsible for ensuring that the labels are maintained as required on the containers in your facility, and that newly purchased materials are checked for labels prior to use.

#### B. Material Safety Data Sheets

Chemical manufacturers and importers are required to obtain or develop a material safety data sheet for each hazardous chemical they produce or import. Distributors are responsible for ensuring that their customers are provided a copy of these MSDSs. Employers must have an MSDS for each hazardous chemical which they use. Employers may rely on the information received from their suppliers. The specific requirements for material safety data sheets are in paragraph (g) of this section.

There is no specified format for the MSDS under the rule, although there are specific information requirements. OSHA has developed a nonmandatory format, OSHA Form 174, which may be used by chemical manufacturers and importers to comply with the rule. The MSDS must be in English. You are entitled to receive from your supplier a data sheet which includes all of the information required under the rule. If you do not receive one automatically, you should request one. If you receive one that is obviously inadequate, with, for example, blank spaces that are not completed, you should request an appropriately completed one. If your request for a data sheet or for a corrected data sheet does not produce the information needed, you should contact your local OSHA Area Office for assistance in obtaining the MSDS.

The role of MSDSs under the rule is to provide detailed information on each hazardous chemical, including its potential hazardous effects, its physical and chemical characteristics, and recommendations for appropriate protective measures. This information should be useful to you as the employer responsible for designing protective programs, as well as to the workers. If you are not familiar with material safety data sheets and with chemical terminology, you may need to learn to use them yourself. A glossary of MSDS terms may be helpful in this regard. Generally speaking, most employers using hazardous chemicals will primarily be concerned

with MSDS information regarding hazardous effects and recommended protective measures. Focus on the sections of the MSDS that are applicable to your situation.

MSDSs must be readily accessible to employees when they are in their work areas during their workshifts. This may be accomplished in many different ways. You must decide what is appropriate for your particular workplace. Some employers keep the MSDSs in a binder in a central location (e.g., in the pick-up truck on a construction site). Others, particularly in workplaces with large numbers of chemicals, computerize the information and provide access through terminals. As long as employees can get the information when they need it, any approach may be used. The employees must have access to the MSDSs themselves--simply having a system where the information can be read to them over the phone is only permitted under the mobile worksite provision, paragraph (g)(9) of this section, when employees must travel between workplaces during the shift. In this situation, they have access to the MSDSs prior to leaving the primary worksite, and when they return, so the telephone system is simply an emergency arrangement.

In order to ensure that you have a current MSDS for each chemical in the plant as required, and that employee access is provided, the compliance officers will be looking for the following types of information in your written program:

1. Designation of person(s) responsible for obtaining and maintaining the MSDSs;
2. How such sheets are to be maintained in the workplace (e.g., in notebooks in the work area(s) or in a computer with terminal access), and how employees can obtain access to them when they are in their work area during the work shift;
3. Procedures to follow when the MSDS is not received at the time of the first shipment;
4. For producers, procedures to update the MSDS when new and significant health information is found; and,
5. Description of alternatives to actual data sheets in the workplace, if used.

For employers using hazardous chemicals, the most important aspect of the written program in terms of MSDSs is to ensure that someone is responsible for obtaining and maintaining the MSDSs for every hazardous chemical in the workplace. The list of hazardous chemicals

required to be maintained as part of the written program will serve as an inventory. As new chemicals are purchased, the list should be updated. Many companies have found it convenient to include on their purchase orders the name and address of the person designated in their company to receive MSDSs.

#### C. Employee Information and Training

Each employee who may be "exposed" to hazardous chemicals when working must be provided information and trained prior to initial assignment to work with a hazardous chemical, and whenever the hazard changes. "Exposure" or "exposed" under the rule means that "an employee is subjected to a hazardous chemical in the course of employment through any route of entry (inhalation, ingestion, skin contact or absorption, etc.) and includes potential (e.g., accidental or possible) exposure." See paragraph (h) of this section for specific requirements. Information and training may be done either by individual chemical, or by categories of hazards (such as flammability or carcinogenicity). If there are only a few chemicals in the workplace, then you may want to discuss each one individually. Where there are large numbers of chemicals, or the chemicals change frequently, you will probably want to train generally based on the hazard categories (e.g., flammable liquids, corrosive materials, carcinogens). Employees will have access to the substance-specific information on the labels and MSDSs.

Information and training is a critical part of the hazard communication program. Information regarding hazards and protective measures are provided to workers through written labels and material safety data sheets. However, through effective information and training, workers will learn to read and understand such information, determine how it can be obtained and used in their own workplaces, and understand the risks of exposure to the chemicals in their workplaces as well as the ways to protect themselves. A properly conducted training program will ensure comprehension and understanding. It is not sufficient to either just read material to the workers, or simply hand them material to read. You want to create a climate where workers feel free to ask questions. This will help you to ensure that the information is understood. You must always remember that the underlying purpose of the HCS is to reduce the incidence of chemical

source illnesses and injuries. This will be accomplished by modifying behavior through the provision of hazard information and information about protective measures. If your program works, you and your workers will better understand the chemical hazards within the workplace. The procedures you establish regarding, for example, purchasing, storage, and handling of these chemicals will improve, and thereby reduce the risks posed to employees exposed to the chemical hazards involved. Furthermore, your workers' comprehension will also be increased, and proper work practices will be followed in your workplace.

If you are going to do the training yourself, you will have to understand the material and be prepared to motivate the workers to learn. This is not always an easy task, but the benefits are worth the effort. More information regarding appropriate training can be found in OSHA Publication No. 2254 which contains voluntary training guidelines prepared by OSHA's Training Institute. A copy of this document is available from OSHA's Publications Office at (202) 219-4667.

In reviewing your written program with regard to information and training, the following items need to be considered:

1. Designation of person(s) responsible for conducting training;
2. Format of the program to be used (audiovisuals, classroom instruction, etc.);
3. Elements of the training program (should be consistent with the elements in paragraph (h) of this section); and,
4. Procedure to train new employees at the time of their initial assignment to work with a hazardous chemical, and to train employees when a new hazard is introduced into the workplace.

The written program should provide enough details about the employer's plans in this area to assess whether or not a good faith effort is being made to train employees. OSHA does not expect that every worker will be able to recite all of the information about each chemical in the workplace. In general, the most important aspects of training under the HCS are to ensure that employees are aware that they are exposed to hazardous chemicals, that they know how to read and use labels and material safety data sheets, and that, as a consequence of learning this information, they are following the appropriate protective measures established by the employer. OSHA compliance officers will be

talking to employees to determine if they have received training, if they know they are exposed to hazardous chemicals, and if they know where to obtain substance-specific information on labels and MSDSs.

The rule does not require employers to maintain records of employee training, but many employers choose to do so. This may help you monitor your own program to ensure that all employees are appropriately trained. If you already have a training program, you may simply have to supplement it with whatever additional information is required under the HCS. For example, construction employers that are already in compliance with the construction training standard (29 CFR 1926.21) will have little extra training to do.

An employer can provide employees information and training through whatever means are found appropriate and protective. Although there would always have to be some training on-site (such as informing employees of the location and availability of the written program and MSDSs), employee training may be satisfied in part by general training about the requirements of the HCS and about chemical hazards on the job which is provided by, for example, trade associations, unions, colleges, and professional schools. In addition, previous training, education and experience of a worker may relieve the employer of some of the burdens of informing and training that worker. Regardless of the method relied upon, however, the employer is always ultimately responsible for ensuring that employees are adequately trained. If the compliance officer finds that the training is deficient, the employer will be cited for the deficiency regardless of who actually provided the training on behalf of the employer.

#### D. Other Requirements

In addition to these specific items, compliance officers will also be asking the following questions in assessing the adequacy of the program:

Does a list of the hazardous chemicals exist in each work area or at a central location?

Are methods the employer will use to inform employees of the hazards of nonroutine tasks outlined?

Are employees informed of the hazards associated with chemicals contained in unlabeled pipes in their work areas?

On multiemployer worksites, has the employer provided other employers with information about labeling systems and precautionary measures where the other employers have employees exposed to the initial employer's chemicals?

Is the written program made available to employees and their designated representatives?

If your program adequately addresses the means of communicating information to employees in your workplace, and provides answers to the basic questions outlined above, it will be found to be in compliance with the rule.

### 5. Checklist for Compliance

The following checklist will help to ensure you are in compliance with the rule:

Obtained a copy of the rule. \_\_\_\_\_  
Read and understood the requirements. \_\_\_\_\_  
Assigned responsibility for tasks. \_\_\_\_\_  
Prepared an inventory of chemicals. \_\_\_\_\_  
Ensured containers are labeled. \_\_\_\_\_  
Obtained MSDS for each chemical. \_\_\_\_\_  
Prepared written program. \_\_\_\_\_  
Made MSDSs available to workers. \_\_\_\_\_  
Conducted training of workers. \_\_\_\_\_  
Established procedures to maintain current program. \_\_\_\_\_  
Established procedures to evaluate effectiveness. \_\_\_\_\_

### 6. Further Assistance

If you have a question regarding compliance with the HCS, you should contact your local OSHA Area Office for assistance. In addition, each OSHA Regional Office has a Hazard Communication Coordinator who can answer your questions. Free consultation services are also available to assist employers, and information regarding these services can be obtained through the Area and Regional offices as well.

The telephone number for the OSHA office closest to you should be listed in your local telephone directory. If you are not able to obtain this information, you may contact OSHA's Office of Information and Consumer Affairs at (202) 219-8151 for further assistance in identifying the appropriate contacts.

[59 FR 6170, Feb. 9, 1994, as amended at 59 FR 17479, Apr. 13, 1994; 59 FR 65948, Dec. 22, 1994; 61 FR 9245, Mar. 7, 1996]



**SUBPART J GENERAL ENVIRONMENTAL CONTROLS****1910.146 Permit-required confined spaces****(a) Scope and application.**

This section contains requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces. This section does not apply to agriculture, to construction, or to shipyard employment (Parts 1928, 1926, and 1915 of this chapter, respectively).

**(b) Definitions.**

**Acceptable entry conditions** means the conditions that must exist in a permit space to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter into and work within the space.

**Attendant** means an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program.

**Authorized entrant** means an employee who is authorized by the employer to enter a permit space.

**Blanking or blinding** means the absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.

**Confined space** means a space that:

- (1) Is large enough and so configured that an employee can bodily enter and perform assigned work; and
- (2) Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and
- (3) Is not designed for continuous employee occupancy.

**Double block and bleed** means the closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

**Emergency** means any occurrence (including any failure of hazard control or monitoring equipment) or event internal or external to the permit space that could endanger entrants.

**Engulfment** means the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

**Entry** means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

**Entry permit (permit)** means the written or printed document that is provided by the employer to allow and control entry into a permit space and that contains the information specified in paragraph (f) of this section.

**Entry supervisor** means the person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this section.

**Note:** An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required by this section for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

**Hazardous atmosphere** means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes:

- (1) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);
- (2) Airborne combustible dust at a concentration that meets or exceeds its LFL;

**Note:** This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.

- (3) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;

- (4) Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health

and Environmental Control, or in Subpart Z, Toxic and Hazardous Substances, of this part and which could result in employee exposure in excess of its dose or permissible exposure limit;

**Note:** An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision.

(5) Any other atmospheric condition that is immediately dangerous to life or health.

**Note:** For air contaminants for which OSHA has not determined a dose or permissible exposure limit, other sources of information, such as Material Safety Data Sheets that comply with the Hazard Communication Standard, Sec. 1910.1200 of this part, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

**Hot work permit** means the employer's written authorization to perform operations (for example, riveting, welding, cutting, burning, and heating) capable of providing a source of ignition.

**Immediately dangerous to life or health (IDLH)** means any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.

**Note:** Some materials--hydrogen fluoride gas and cadmium vapor, for example--may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

**Inerting** means the displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible.

**Note:** This procedure produces an IDLH oxygen-deficient atmosphere.

**Isolation** means the process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout

of all sources of energy; or blocking or disconnecting all mechanical linkages.

**Line breaking** means the intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

**Non-permit confined space** means a confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

**Oxygen deficient atmosphere** means an atmosphere containing less than 19.5 percent oxygen by volume.

**Oxygen enriched atmosphere** means an atmosphere containing more than 23.5 percent oxygen by volume.

**Permit-required confined space (permit space)** means a confined space that has one or more of the following characteristics:

- (1) Contains or has a potential to contain a hazardous atmosphere;
- (2) Contains a material that has the potential for engulfing an entrant;
- (3) Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
- (4) Contains any other recognized serious safety or health hazard.

**Permit-required confined space program (permit space program)** means the employer's overall program for controlling, and, where appropriate, for protecting employees from, permit space hazards and for regulating employee entry into permit spaces.

**Permit system** means the employer's written procedure for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.

**Prohibited condition** means any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

**Rescue service** means the personnel designated to rescue employees from permit spaces.

**Retrieval system** means the equipment (including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.

**Testing** means the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

**Note:** Testing enables employers both to devise and implement adequate control measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to, and during, entry.

**(c) General requirements.**

(1) The employer shall evaluate the workplace to determine if any spaces are permit-required confined spaces.

**Note:** Proper application of the decision flow chart in appendix A to Sec. 1910.146 would facilitate compliance with this requirement.

(2) If the workplace contains permit spaces, the employer shall inform exposed employees, by posting danger signs or by any other equally effective means, of the existence and location of and the danger posed by the permit spaces.

**Note:** A sign reading "DANGER--PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER" or using other similar language would satisfy the requirement for a sign.

(3) If the employer decides that its employees will not enter permit spaces, the employer shall take effective measures to prevent its employees from entering the permit spaces and shall comply with paragraphs (c)(1), (c)(2), (c)(6), and (c)(8) of this section.

(4) If the employer decides that its employees will enter permit spaces, the employer shall develop and implement a written permit space program that complies with this section. The written program shall be available for inspection by employees and their authorized representatives.

(5) An employer may use the alternate procedures specified in paragraph (c)(5)(ii) of this section for entering a permit space under the conditions set forth in paragraph (c)(5)(i) of this section.

(i) An employer whose employees enter a permit space need not comply with paragraphs (d) through (f) and (h) through (k) of this section, provided that:

(A) The employer can demonstrate that the only hazard posed by the permit space is an actual or potential hazardous atmosphere;

(B) The employer can demonstrate that continuous forced air ventilation alone is sufficient to maintain that permit space safe for entry;

(C) The employer develops monitoring and inspection data that supports the demonstrations required by paragraphs (c)(5)(i)(A) and (c)(5)(i)(B) of this section;

(D) If an initial entry of the permit space is necessary to obtain the data required by paragraph (c)(5)(i)(C) of this section, the entry is performed in compliance with paragraphs (d) through (k) of this section;

(E) The determinations and supporting data required by paragraphs (c)(5)(i)(A), (c)(5)(i)(B), and (c)(5)(i)(C) of this section are documented by the employer and are made available to each employee who enters the permit space under the terms of paragraph (c)(5) of this section or to that employee's authorized representative; and

(F) Entry into the permit space under the terms of paragraph (c)(5)(i) of this section is performed in accordance with the requirements of paragraph (c)(5)(ii) of this section.

**Note:** See paragraph (c)(7) of this section for reclassification of a permit space after all hazards within the space have been eliminated.

(ii) The following requirements apply to entry into permit spaces that meet the conditions set forth in paragraph (c)(5)(i) of this section.

(A) Any conditions making it unsafe to remove an entrance cover shall be eliminated before the cover is removed.

(B) When entrance covers are removed, the opening shall be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and that will protect each employee working in the space from foreign objects entering the space.

(C) Before an employee enters the space, the internal atmosphere shall be tested, with a calibrated direct-reading instrument, for oxygen content, for flammable gases and vapors, and for potential toxic air contaminants, in that order. Any employee who enters the space, or that employee's authorized representative, shall be provided an opportunity to observe the pre-entry testing required by this paragraph.

(D) There may be no hazardous atmosphere within the space whenever any employee is inside the space.

(E) Continuous forced air ventilation shall be used, as follows:

(1) An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere;

(2) The forced air ventilation shall be so directed as to ventilate the immediate areas where an employee is or will be present within the space and shall continue until all employees have left the space;

(3) The air supply for the forced air ventilation shall be from a clean source and may not increase the hazards in the space.

(F) The atmosphere within the space shall be periodically tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere. Any employee who enters the space, or that employee's authorized representative, shall be provided with an opportunity to observe the periodic testing required by this paragraph.

(G) If a hazardous atmosphere is detected during entry:

(1) Each employee shall leave the space immediately;

(2) The space shall be evaluated to determine how the hazardous atmosphere developed; and

(3) Measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

(H) The employer shall verify that the space is safe for entry and that the pre-entry measures required by paragraph (c)(5)(ii) of this section have been taken, through a written certification that contains the date, the location of the space, and the signature of the person providing the certification. The certification shall be made before entry and shall be made available to each employee entering the space or to that employee's authorized representative .

(6) When there are changes in the use or configuration of a non-permit confined space that might increase the hazards to entrants, the employer shall reevaluate that space and, if necessary, reclassify it as a permit-required confined space.

(7) A space classified by the employer as a permit-required confined space may be reclassified as a non-permit confined space under the following procedures:

(i) If the permit space poses no actual or potential atmospheric hazards and if all hazards within the space are eliminated without entry into the space, the permit space may be

reclassified as a non-permit confined space for as long as the non-atmospheric hazards remain eliminated.

(ii) If it is necessary to enter the permit space to eliminate hazards, such entry shall be performed under paragraphs (d) through (k) of this section. If testing and inspection during that entry demonstrate that the hazards within the permit space have been eliminated, the permit space may be reclassified as a non-permit confined space for as long as the hazards remain eliminated.

**Note:** Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards. Paragraph (c)(5) covers permit space entry where the employer can demonstrate that forced air ventilation alone will control all hazards in the space.

(iii) The employer shall document the basis for determining that all hazards in a permit space have been eliminated, through a certification that contains the date, the location of the space, and the signature of the person making the determination. The certification shall be made available to each employee entering the space or to that employee's authorized representative.

(iv) If hazards arise within a permit space that has been declassified to a non-permit space under paragraph (c)(7) of this section, each employee in the space shall exit the space. The employer shall then reevaluate the space and determine whether it must be reclassified as a permit space, in accordance with other applicable provisions of this section.

(8) When an employer (host employer) arranges to have employees of another employer (contractor) perform work that involves permit space entry, the host employer shall:

(i) Inform the contractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements of this section;

(ii) Apprise the contractor of the elements, including the hazards identified and the host employer's experience with the space, that make the space in question a permit space;

(iii) Apprise the contractor of any precautions or procedures that the host employer has implemented for the protection of employees in or near permit spaces where contractor personnel will be working;

(iv) Coordinate entry operations with the contractor, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and

(v) Debrief the contractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations.

(9) In addition to complying with the permit space requirements that apply to all employers, each contractor who is retained to perform permit space entry operations shall:

(i) Obtain any available information regarding permit space hazards and entry operations from the host employer;

(ii) Coordinate entry operations with the host employer, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and

(iii) Inform the host employer of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces, either through a debriefing or during the entry operation.

**(d) Permit-required confined space program (permit space program).**

Under the permit space program required by paragraph (c)(4) of this section, the employer shall:

(1) Implement the measures necessary to prevent unauthorized entry;

(2) Identify and evaluate the hazards of permit spaces before employees enter them;

(3) Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following:

(i) Specifying acceptable entry conditions;

(ii) Providing each authorized entrant or that employee's authorized representative with the opportunity to observe any monitoring or testing of permit spaces;

(iii) Isolating the permit space;

(iv) Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards;

B Providing pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards; and

(vi) Verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

(4) Provide the following equipment (specified in paragraphs (d)(4)(i) through (d)(4)(ix) of this section) at no cost to employees, maintain that equipment properly, and ensure that employees use that equipment properly:

(i) Testing and monitoring equipment needed to comply with paragraph (d)(5) of this section;

(ii) Ventilating equipment needed to obtain acceptable entry conditions;

(iii) Communications equipment necessary for compliance with paragraphs (h)(3) and (i)(5) of this section;

(iv) Personal protective equipment insofar as feasible engineering and work practice controls do not adequately protect employees;

(v) Lighting equipment needed to enable employees to see well enough to work safely and to exit the space quickly in an emergency;

(vi) Barriers and shields as required by paragraph (d)(3)(iv) of this section;

(vii) Equipment, such as ladders, needed for safe ingress and egress by authorized entrants;

(viii) Rescue and emergency equipment needed to comply with paragraph (d)(9) of this section, except to the extent that the equipment is provided by rescue services; and

(ix) Any other equipment necessary for safe entry into and rescue from permit spaces.

(5) Evaluate permit space conditions as follows when entry operations are conducted:

(i) Test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin, except that, if isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working;

(ii) Test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations; and

(iii) When testing for atmospheric hazards, test first for oxygen, then for combustible gases and vapors, and then for toxic gases and vapors.

(iv) Provide each authorized entrant or that employee's authorized representative an opportunity to observe the pre-entry and any subsequent testing or monitoring of permit spaces;

(v) Reevaluate the permit space in the presence of any authorized entrant or that employee's authorized representative who requests that the employer conduct such reevaluation because the entrant or representative has reason to believe that the evaluation of that space may not have been adequate;

(vi) Immediately provide each authorized entrant or that employee's authorized representative with the results of any testing conducted in accord with paragraph (d) of this section.

**Note:** Atmospheric testing conducted in accordance with appendix B to Sec. 1910.146 would be considered as satisfying the requirements of this paragraph. For permit space operations in sewers, atmospheric testing conducted in accordance with appendix B, as supplemented by appendix E to Sec. 1910.146, would be considered as satisfying the requirements of this paragraph.

(6) Provide at least one attendant outside the permit space into which entry is authorized for the duration of entry operations;

**Note:** Attendants may be assigned to monitor more than one permit space provided the duties described in paragraph (i) of this section can be effectively performed for each permit space that is monitored. Likewise, attendants may be stationed at any location outside the permit space to be monitored as long as the duties described in paragraph (i) of this section can be effectively performed for each permit space that is monitored.

(7) If multiple spaces are to be monitored by a single attendant, include in the permit program the means and procedures to enable the attendant to respond to an emergency affecting one or more of the permit spaces being monitored without distraction from the attendant's responsibilities under paragraph (i) of this section;

(8) Designate the persons who are to have active roles (as, for example, authorized entrants, attendants, entry supervisors, or persons who test or monitor the atmosphere in a permit space) in entry operations, identify the duties of each such employee, and provide each such employee

with the training required by paragraph (g) of this section;

(9) Develop and implement procedures for summoning rescue and emergency services, for rescuing entrants from permit spaces, for providing necessary emergency services to rescued employees, and for preventing unauthorized personnel from attempting a rescue;

(10) Develop and implement a system for the preparation, issuance, use, and cancellation of entry permits as required by this section;

(11) Develop and implement procedures to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants in a permit space, so that employees of one employer do not endanger the employees of any other employer;

(12) Develop and implement procedures (such as closing off a permit space and canceling the permit) necessary for concluding the entry after entry operations have been completed;

(13) Review entry operations when the employer has reason to believe that the measures taken under the permit space program may not protect employees and revise the program to correct deficiencies found to exist before subsequent entries are authorized; and

**Note:** Examples of circumstances requiring the review of the permit space program are: any unauthorized entry of a permit space, the detection of a permit space hazard not covered by the permit, the detection of a condition prohibited by the permit, the occurrence of an injury or near-miss during entry, a change in the use or configuration of a permit space, and employee complaints about the effectiveness of the program.

(14) Review the permit space program, using the canceled permits retained under paragraph (e)(6) of this section within 1 year after each entry and revise the program as necessary, to ensure that employees participating in entry operations are protected from permit space hazards.

**Note:** Employers may perform a single annual review covering all entries performed during a 12-month period. If no entry is performed during a 12-month period, no review is necessary.

Appendix C to Sec. 1910.146 presents examples of permit space programs that are considered to comply with the requirements of paragraph (d) of this section.

**(e) Permit system.**

(1) Before entry is authorized, the employer shall document the completion of measures required by paragraph (d)(3) of this section by preparing an entry permit.

**Note:** Appendix D to Sec. 1910.146 presents examples of permits whose elements are considered to comply with the requirements of this section.

(2) Before entry begins, the entry supervisor identified on the permit shall sign the entry permit to authorize entry.

(3) The completed permit shall be made available at the time of entry to all authorized entrants or their authorized representatives, by posting it at the entry portal or by any other equally effective means, so that the entrants can confirm that pre-entry preparations have been completed.

(4) The duration of the permit may not exceed the time required to complete the assigned task or job identified on the permit in accordance with paragraph (f)(2) of this section.

(5) The entry supervisor shall terminate entry and cancel the entry permit when:

(i) The entry operations covered by the entry permit have been completed; or

(ii) A condition that is not allowed under the entry permit arises in or near the permit space.

(6) The employer shall retain each canceled entry permit for at least 1 year to facilitate the review of the permit-required confined space program required by paragraph (d)(14) of this section. Any problems encountered during an entry operation shall be noted on the pertinent permit so that appropriate revisions to the permit space program can be made.

**(f) Entry permit.**

The entry permit that documents compliance with this section and authorizes entry to a permit space shall identify:

(1) The permit space to be entered;

(2) The purpose of the entry;

(3) The date and the authorized duration of the entry permit;

(4) The authorized entrants within the permit space, by name or by such other means (for example, through the use of rosters or tracking systems) as will enable the attendant to determine quickly and accurately, for the

duration of the permit, which authorized entrants are inside the permit space;

**Note:** This requirement may be met by inserting a reference on the entry permit as to the means used, such as a roster or tracking system, to keep track of the authorized entrants within the permit space.

(5) The personnel, by name, currently serving as attendants;

(6) The individual, by name, currently serving as entry supervisor, with a space for the signature or initials of the entry supervisor who originally authorized entry;

(7) The hazards of the permit space to be entered;

(8) The measures used to isolate the permit space and to eliminate or control permit space hazards before entry;

**Note:** Those measures can include the lockout or tagging of equipment and procedures for purging, inerting, ventilating, and flushing permit spaces.

(9) The acceptable entry conditions;

(10) The results of initial and periodic tests performed under paragraph (d)(5) of this section, accompanied by the names or initials of the testers and by an indication of when the tests were performed;

(11) The rescue and emergency services that can be summoned and the means (such as the equipment to use and the numbers to call) for summoning those services;

(12) The communication procedures used by authorized entrants and attendants to maintain contact during the entry;

(13) Equipment, such as personal protective equipment, testing equipment, communications equipment, alarm systems, and rescue equipment, to be provided for compliance with this section;

(14) Any other information whose inclusion is necessary, given the circumstances of the particular confined space, in order to ensure employee safety; and

(15) Any additional permits, such as for hot work, that have been issued to authorize work in the permit space.

**(g) Training.**

(1) The employer shall provide training so that all employees whose work is regulated by this section acquire the understanding, knowledge, and skills necessary for the safe

performance of the duties assigned under this section.

(2) Training shall be provided to each affected employee:

(i) Before the employee is first assigned duties under this section;

(ii) Before there is a change in assigned duties;

(iii) Whenever there is a change in permit space operations that presents a hazard about which an employee has not previously been trained;

(iv) Whenever the employer has reason to believe either that there are deviations from the permit space entry procedures required by paragraph (d)(3) of this section or that there are inadequacies in the employee's knowledge or use of these procedures.

(3) The training shall establish employee proficiency in the duties required by this section and shall introduce new or revised procedures, as necessary, for compliance with this section.

(4) The employer shall certify that the training required by paragraphs (g)(1) through (g)(3) of this section has been accomplished. The certification shall contain each employee's name, the signatures or initials of the trainers, and the dates of training. The certification shall be available for inspection by employees and their authorized representatives.

#### **(h) Duties of authorized entrants.**

The employer shall ensure that all authorized entrants:

(1) Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(2) Properly use equipment as required by paragraph (d)(4) of this section;

(3) Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space as required by paragraph (i)(6) of this section;

(4) Alert the attendant whenever:

(i) The entrant recognizes any warning sign or symptom of exposure to a dangerous situation, or

(ii) The entrant detects a prohibited condition; and

(5) Exit from the permit space as quickly as possible whenever:

(i) An order to evacuate is given by the attendant or the entry supervisor,

(ii) The entrant recognizes any warning sign or symptom of exposure to a dangerous situation,

(iii) The entrant detects a prohibited condition, or

(iv) An evacuation alarm is activated.

#### **(i) Duties of attendants.**

The employer shall ensure that each attendant:

(1) Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(2) Is aware of possible behavioral effects of hazard exposure in authorized entrants;

(3) Continuously maintains an accurate count of authorized entrants in the permit space and ensures that the means used to identify authorized entrants under paragraph (f)(4) of this section accurately identifies who is in the permit space;

(4) Remains outside the permit space during entry operations until relieved by another attendant;

**Note:** When the employer's permit entry program allows attendant entry for rescue, attendants may enter a permit space to attempt a rescue if they have been trained and equipped for rescue operations as required by paragraph (k)(1) of this section and if they have been relieved as required by paragraph (i)(4) of this section.

(5) Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space under paragraph (i)(6) of this section;

(6) Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following conditions;

(i) If the attendant detects a prohibited condition;

(ii) If the attendant detects the behavioral effects of hazard exposure in an authorized entrant;

(iii) If the attendant detects a situation outside the space that could endanger the authorized entrants; or

(iv) If the attendant cannot effectively and safely perform all the duties required under paragraph (i) of this section;

(7) Summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards;

(8) Takes the following actions when unauthorized persons approach or enter a permit space while entry is underway:

(i) Warn the unauthorized persons that they must stay away from the permit space;

(ii) Advise the unauthorized persons that they must exit immediately if they have entered the permit space; and

(iii) Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space;

(9) Performs non-entry rescues as specified by the employer's rescue procedure; and

(10) Performs no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

#### **(j) Duties of entry supervisors.**

The employer shall ensure that each entry supervisor:

(1) Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(2) Verifies, by checking that the appropriate entries have been made on the permit, that all tests specified by the permit have been conducted and that all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin;

(3) Terminates the entry and cancels the permit as required by paragraph (e)(5) of this section;

(4) Verifies that rescue services are available and that the means for summoning them are operable;

(5) Removes unauthorized individuals who enter or who attempt to enter the permit space during entry operations; and

(6) Determines, whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space, that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained.

#### **(k) Rescue and emergency services.**

(1) An employer who designates rescue and emergency services, pursuant to paragraph (d)(9) of this section, shall:

(i) Evaluate a prospective rescuer's ability to respond to a rescue summons in a timely manner, considering the hazard(s) identified;

**Note to paragraph (k)(1)(i):** What will be considered timely will vary according to the specific hazards involved in each entry. For example, Sec. 1910.134, Respiratory Protection, requires that employers provide a standby person or persons capable of immediate action to rescue employee(s) wearing respiratory protection while in work areas defined as IDLH atmospheres.

(ii) Evaluate a prospective rescue service's ability, in terms of proficiency with rescue-related tasks and equipment, to function appropriately while rescuing entrants from the particular permit space or types of permit spaces identified;

(iii) Select a rescue team or service from those evaluated that:

(A) Has the capability to reach the victim(s) within a time frame that is appropriate for the permit space hazard(s) identified;

(B) Is equipped for and proficient in performing the needed rescue services;

(iv) Inform each rescue team or service of the hazards they may confront when called on to perform rescue at the site; and

(v) Provide the rescue team or service selected with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations.

**Note to paragraph (k)(1):** Non-mandatory appendix F contains examples of criteria which employers can use in evaluating prospective rescuers as required by paragraph (k)(1) of this section.

(2) An employer whose employees have been designated to provide permit space rescue and emergency services shall take the following measures:

(i) Provide affected employees with the personal protective equipment (PPE) needed to conduct permit space rescues safely and train affected employees so they are proficient in the use of that PPE, at no cost to those employees;

(ii) Train affected employees to perform assigned rescue duties. The employer must ensure that such employees successfully complete

the training required to establish proficiency as an authorized entrant, as provided by paragraphs (g) and (h) of this section;

(iii) Train affected employees in basic first-aid and cardiopulmonary resuscitation (CPR). The employer shall ensure that at least one member of the rescue team or service holding a current certification in first aid and CPR is available; and

(iv) Ensure that affected employees practice making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove dummies, manikins, or actual persons from the actual permit spaces or from representative permit spaces. Representative permit spaces shall, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which rescue is to be performed.

(3) To facilitate non-entry rescue, retrieval systems or methods shall be used whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet the following requirements.

(i) Each authorized entrant shall use a chest or full body harness, with a retrieval line attached at the center of the entrant's back near shoulder level, above the entrant's head, or at another point which the employer can establish presents a profile small enough for the successful removal of the entrant.

Wristlets may be used in lieu of the chest or full body harness if the employer can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

(ii) The other end of the retrieval line shall be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical type permit spaces more than 5 feet (1.52 m) deep.

(4) If an injured entrant is exposed to a substance for which a Material Safety Data Sheet (MSDS) or other similar written information is required to be kept at the worksite, that MSDS or written information shall be made available to the medical facility treating the exposed entrant.

(I) Employee participation. (1) Employers shall consult with affected employees and their

authorized representatives on the development and implementation of all aspects of the permit space program required by paragraph (c) of this section.

(2) Employers shall make available to affected employees and their authorized representatives all information required to be developed by this section.

#### **APPENDICES TO Sec. 1910.146--PERMIT-REQUIRED CONFINED SPACES**

**Note:** Appendices A through F serve to provide information and non-mandatory guidelines to assist employers and employees in complying with the appropriate requirements of this section.

##### **Appendix A to Sec. 1910.146--Permit-Required Confined Space Decision Flow Chart**

See next page.

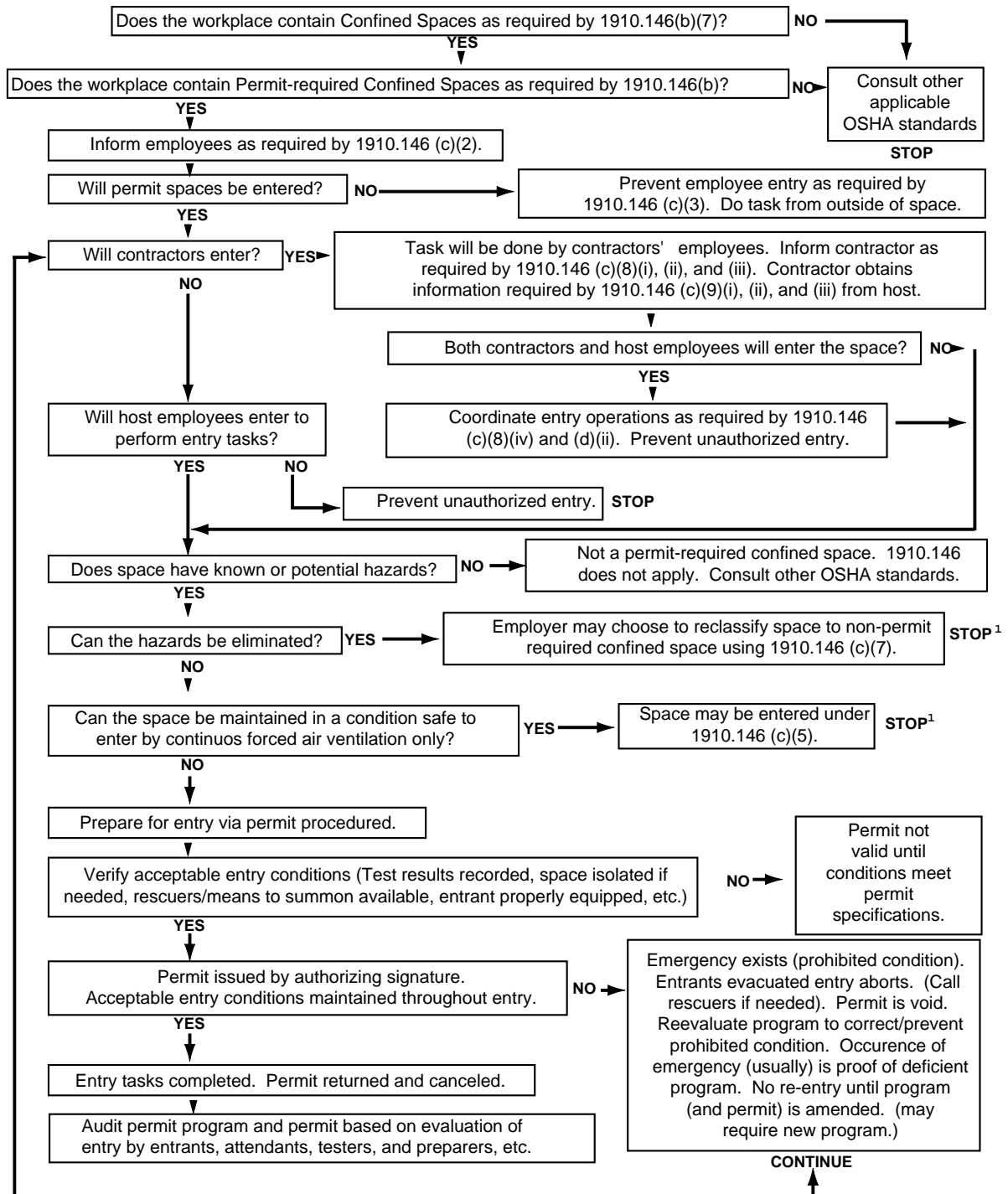
##### **Appendix B to Sec. 1910.146--Procedures for Atmospheric Testing**

Atmospheric testing is required for two distinct purposes: evaluation of the hazards of the permit space and verification that acceptable entry conditions for entry into that space exist.

(1) **Evaluation testing.** The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate permit entry procedures can be developed and acceptable entry conditions stipulated for that space. Evaluation and interpretation of these data, and development of the entry procedure, should be done by, or reviewed by, a technically qualified professional (e.g., OSHA consultation service, or certified industrial hygienist, registered safety engineer, certified safety professional, certified marine chemist, etc.) based on evaluation of all serious hazards.

(2) **Verification testing.** The atmosphere of a permit space which may contain a hazardous atmosphere should be tested for residues of all contaminants identified by evaluation testing using permit specified equipment to determine that residual concentrations at the time of testing and entry are within the range of acceptable entry conditions. Results of testing

**Appendix A to 1910.146 - Permit-Required  
Confined Space Decision Flow Chart**



58 FR 4549, Jan. 14, 1993; 58 FR 34846, June 29, 1993; 63 FR 66039, Dec. 1, 1998

(i.e., actual concentration, etc.) should be recorded on the permit in the space provided adjacent to the stipulated acceptable entry condition.

**(3) Duration of testing.** Measurement of values for each atmospheric parameter should be made for at least the minimum response time of the test instrument specified by the manufacturer.

**(4) Testing stratified atmospheres.** When monitoring for entries involving a descent into atmospheres that may be stratified, the atmospheric envelope should be tested a distance of approximately 4 feet (1.22 m) in the direction of travel and to each side. If a sampling probe is used, the entrant's rate of progress should be slowed to accommodate the sampling speed and detector response.

**(5) Order of testing.** A test for oxygen is performed first because most combustible gas meters are oxygen dependent and will not provide reliable readings in an oxygen deficient atmosphere. Combustible gasses are tested for next because the threat of fire or explosion is both more immediate and more life threatening, in most cases, than exposure to toxic gasses and vapors. If tests for toxic gasses and vapors are necessary, they are performed last.

## Appendix C to Sec. 1910.146--Examples of Permit-Required Confined Space Programs

### Example 1.

#### Workplace. Sewer entry.

**Potential hazards.** The employees could be exposed to the following:

**Engulfment.** Presence of toxic gases. Equal to or more than 10 ppm hydrogen sulfide measured as an 8-hour time-weighted average. If the presence of other toxic contaminants is suspected, specific monitoring programs will be developed.

**Presence of explosive/flammable gases.** Equal to or greater than 10% of the lower flammable limit (LFL).

**Oxygen Deficiency.** A concentration of oxygen in the atmosphere equal to or less than 19.5% by volume.

## A. ENTRY WITHOUT PERMIT/ATTENDANT

**Certification.** Confined spaces may be entered without the need for a written permit or attendant provided that the space can be maintained in a safe condition for entry by mechanical ventilation alone, as provided in Sec. 1910.146(c)(5). All spaces shall be considered permit-required confined spaces until the pre-entry procedures demonstrate otherwise. Any employee required or permitted to pre-check or enter an enclosed/confined space shall have successfully completed, -as a minimum, the training as required by the following sections of these procedures. A written copy of operating and rescue procedures as required by these procedures shall be at the work site for the duration of the job. The Confined Space Pre-Entry Check List must be completed by the LEAD WORKER before entry into a confined space. This list verifies completion of items listed below. This check list shall be kept at the job site for duration of the job. If circumstances dictate an interruption in the work, the permit space must be re-evaluated and a new check list must be completed.

### Control of atmospheric and engulfment hazards.

**Pumps and Lines.** All pumps and lines which may reasonably cause contaminants to flow into the space shall be disconnected, blinded and locked out, or effectively isolated by other means to prevent development of dangerous air contamination or engulfment. Not all laterals to sewers or storm drains require blocking. However, where experience or knowledge of industrial use indicates there is a reasonable potential for contamination of air or engulfment into an occupied sewer, then all affected laterals shall be blocked. If blocking and/or isolation requires entry into the space the provisions for entry into a permit- required confined space must be implemented.

**Surveillance.** The surrounding area shall be surveyed to avoid hazards such as drifting vapors from the tanks, piping, or sewers.

**Testing.** The atmosphere within the space will be tested to determine whether dangerous air contamination and/or oxygen deficiency exists. Detector tubes, alarm only gas monitors and explosion meters are examples of monitoring equipment that may be used to test permit space atmospheres. Testing shall be performed by the

LEAD WORKER who has successfully completed the Gas Detector training for the monitor he will use. The minimum parameters to be monitored are oxygen deficiency, LFL, and hydrogen sulfide concentration. A written record of the pre-entry test results shall be made and kept at the work site for the duration of the job. The supervisor will certify in writing, based upon the results of the pre-entry testing, that all hazards have been eliminated. Affected employees shall be able to review the testing results. The most hazardous conditions shall govern when work is being performed in two adjoining, connecting spaces.

**Entry Procedures.** If there are no non-atmospheric hazards present and if the pre-entry tests show there is no dangerous air contamination and/or oxygen deficiency within the space and there is no reason to believe that any is likely to develop, entry into and work within may proceed. Continuous testing of the atmosphere in the immediate vicinity of the workers within the space shall be accomplished. The workers will immediately leave the permit space when any of the gas monitor alarm set points are reached as defined. Workers will not return to the area until a SUPERVISOR who has completed the gas detector training has used a direct reading gas detector to evaluate the situation and has determined that it is safe to enter.

**Rescue.** Arrangements for rescue services are not required where there is no attendant. See the rescue portion of section B., below, for instructions regarding rescue planning where an entry permit is required.

## B. ENTRY PERMIT REQUIRED

**Permits.** Confined Space Entry Permit. All spaces shall be considered permit-required confined spaces until the pre-entry procedures demonstrate otherwise. Any employee required or permitted to pre-check or enter a permit-required confined space shall have successfully completed, as a minimum, the training as required by the following sections of these procedures. A written copy of operating and rescue procedures as required by these procedures shall be at the work site for the duration of the job. The Confined Space Entry Permit must be completed before approval can be given to enter a permit-required confined space. This permit verifies completion of

items listed below. This permit shall be kept at the job site for the duration of the job. If circumstances cause an interruption in the work or a change in the alarm conditions for which entry was approved, a new Confined Space Entry Permit must be completed.

### Control of atmospheric and engulfment hazards.

**Surveillance.** The surrounding area shall be surveyed to avoid hazards such as drifting vapors from tanks, piping or sewers.

**Testing.** The confined space atmosphere shall be tested to determine whether dangerous air contamination and/or oxygen deficiency exists. A direct reading gas monitor shall be used. Testing shall be performed by the SUPERVISOR who has successfully completed the gas detector training for the monitor he will use. The minimum parameters to be monitored are oxygen deficiency, LFL and hydrogen sulfide concentration. A written record of the pre-entry test results shall be made and kept at the work site for the duration of the job. Affected employees shall be able to review the testing results. The most hazardous conditions shall govern when work is being performed in two adjoining, connected spaces.

**Space Ventilation.** Mechanical ventilation systems, where applicable, shall be set at 100% outside air. Where possible, open additional manholes to increase air circulation. Use portable blowers to augment natural circulation if needed. After a suitable ventilating period, repeat the testing. Entry may not begin until testing has demonstrated that the hazardous atmosphere has been eliminated.

**Entry Procedures.** The following procedure shall be observed under any of the following conditions: 1.) Testing demonstrates the existence of dangerous or deficient conditions and additional ventilation cannot reduce concentrations to safe levels; 2.) The atmosphere tests as safe but unsafe conditions can reasonably be expected to develop; 3.) It is not feasible to provide for ready exit from spaces equipped with automatic fire suppression systems and it is not practical or safe to deactivate such systems; or 4.) An emergency exists and it is not feasible to wait for pre-entry procedures to take effect.

**All personnel must be trained.** A self contained breathing apparatus shall be worn by any person entering the space. At least one worker shall stand by the outside of the space ready to give assistance in case of emergency. The standby worker shall have a self contained breathing apparatus available for immediate use. There shall be at least one additional worker within sight or call of the standby worker. Continuous powered communications shall be maintained between the worker within the confined space and standby personnel.

If at any time there is any questionable action or non- movement by the worker inside, a verbal check will be made. If there is no response, the worker will be moved immediately. Exception: If the worker is disabled due to falling or impact, he/she shall not be removed from the confined space unless there is immediate danger to his/her life. Local fire department rescue personnel shall be notified immediately. The standby worker may only enter the confined space in case of an emergency (wearing the self contained breathing apparatus) and only after being relieved by another worker. Safety belt or harness with attached lifeline shall be used by all workers entering the space with the free end of the line secured outside the entry opening. The standby worker shall attempt to remove a disabled worker via his lifeline before entering the space.

When practical, these spaces shall be entered through side openings--those within 3 1/2 feet (1.07 m) of the bottom. When entry must be through a top opening, the safety belt shall be of the harness type that suspends a person upright and a hoisting device or similar apparatus shall be available for lifting workers out of the space.

In any situation where their use may endanger the worker, use of a hoisting device or safety belt and attached lifeline may be discontinued.

When dangerous air contamination is attributable to flammable and/or explosive substances, lighting and electrical equipment shall be Class 1, Division 1 rated per National Electrical Code and no ignition sources shall be introduced into the area.

Continuous gas monitoring shall be performed during all confined space operations. If alarm conditions change adversely, entry personnel shall exit the confined space and a new confined space permit issued.

Rescue. Call the fire department services for rescue. Where immediate hazards to injured

personnel are present, workers at the site shall implement emergency procedures to fit the situation.

### **Example 2.**

#### **Workplace. Meat and poultry rendering plants.**

Cookers and dryers are either batch or continuous in their operation. Multiple batch cookers are operated in parallel. When one unit of a multiple set is shut down for repairs, means are available to isolate that unit from the others which remain in operation.

Cookers and dryers are horizontal, cylindrical vessels equipped with a center, rotating shaft and agitator paddles or discs. If the inner shell is jacketed, it is usually heated with steam at pressures up to 150 psig (1034.25 kPa). The rotating shaft assembly of the continuous cooker or dryer is also steam heated.

Potential Hazards. The recognized hazards associated with cookers and dryers are the risk that employees could be:

1. Struck or caught by rotating agitator;
2. Engulfed in raw material or hot, recycled fat;
3. Burned by steam from leaks into the cooker/dryer steam jacket or the condenser duct system if steam valves are not properly closed and locked out;
4. Burned by contact with hot metal surfaces, such as the agitator shaft assembly, or inner shell of the cooker/dryer;
5. Heat stress caused by warm atmosphere inside cooker/dryer;
6. Slipping and falling on grease in the cooker/dryer;
7. Electrically shocked by faulty equipment taken into the cooker/dryer;
8. Burned or overcome by fire or products of combustion; or
9. Overcome by fumes generated by welding or cutting done on grease covered surfaces.

**Permits.** The supervisor in this case is always present at the cooker/dryer or other permit entry confined space when entry is made. The supervisor must follow the pre-entry isolation procedures described in the entry permit in preparing for entry, and ensure that the protective clothing, ventilating equipment and any other equipment required by the permit are at the entry site.

**Control of hazards.** Mechanical. Lock out main power switch to agitator motor at main power panel. Affix tag to the lock to inform others that a permit entry confined space entry is in progress.

**Engulfment.** Close all valves in the raw material blow line. Secure each valve in its closed position using chain and lock. Attach a tag to the valve and chain warning that a permit entry confined space entry is in progress. The same procedure shall be used for securing the fat recycle valve.

**Burns and heat stress.** Close steam supply valves to jacket and secure with chains and tags. Insert solid blank at flange in cooker vent line to condenser manifold duct system. Vent cooker/dryer by opening access door at discharge end and top center door to allow natural ventilation throughout the entry. If faster cooling is needed, use an portable ventilation fan to increase ventilation. Cooling water may be circulated through the jacket to reduce both outer and inner surface temperatures of cooker/dryers faster. Check air and inner surface temperatures in cooker/dryer to assure they are within acceptable limits before entering, or use proper protective clothing.

**Fire and fume hazards.** Careful site preparation, such as cleaning the area within 4 inches (10.16 cm) of all welding or torch cutting operations, and proper ventilation are the preferred controls. All welding and cutting operations shall be done in accordance with the requirements of 29 CFR Part 1910, Subpart Q, OSHA's welding standard. Proper ventilation may be achieved by local exhaust ventilation, or the use of portable ventilation fans, or a combination of the two practices.

**Electrical shock.** Electrical equipment used in cooker/dryers shall be in serviceable condition.

**Slips and falls.** Remove residual grease before entering cooker/dryer.

**Attendant.** The supervisor shall be the attendant for employees entering cooker/dryers.

**Permit.** The permit shall specify how isolation shall be done and any other preparations needed before making entry. This is especially important in parallel arrangements of cooker/dryers so that the entire operation need not be shut down to allow safe entry into one unit.

**Rescue.** When necessary, the attendant shall call the fire department as previously arranged.

### Example 3.

**Workplace.** **Workplaces where tank cars, trucks, and trailers, dry bulk tanks and trailers, railroad tank cars, and similar portable tanks are fabricated or serviced.**

**A. During fabrication.** These tanks and dry-bulk carriers are entered repeatedly throughout the fabrication process. These products are not configured identically, but the manufacturing processes by which they are made are very similar.

**Sources of hazards.** In addition to the mechanical hazards arising from the risks that an entrant would be injured due to contact with components of the tank or the tools being used, there is also the risk that a worker could be injured by breathing fumes from welding materials or mists or vapors from materials used to coat the tank interior. In addition, many of these vapors and mists are flammable, so the failure to properly ventilate a tank could lead to a fire or explosion.

### Control of hazards.

**Welding.** Local exhaust ventilation shall be used to remove welding fumes once the tank or carrier is completed to the point that workers may enter and exit only through a manhole. (Follow the requirements of 29 CFR 1910, Subpart Q, OSHA's welding standard, at all times.) Welding gas tanks may never be brought into a tank or carrier that is a permit entry confined space.

**Application of interior coatings and linings.** Atmospheric hazards shall be controlled by forced air ventilation sufficient to keep the atmospheric concentration of flammable materials below 10% of the lower flammable limit (LFL) (or lower explosive limit (LEL), whichever term is used locally). The appropriate respirators are provided and shall be used in addition to providing forced ventilation if the forced ventilation does not maintain acceptable respiratory conditions.

**Permits.** Because of the repetitive nature of the entries in these operations, an "Area Entry Permit" will be issued for a 1 month period to

cover those production areas where tanks are fabricated to the point that entry and exit are made using manholes.

**Authorization.** Only the area supervisor may authorize an employee to enter a tank within the permit area. The area supervisor must determine that conditions in the tank trailer, dry bulk trailer or truck, etc. meet permit requirements before authorizing entry.

**Attendant.** The area supervisor shall designate an employee to maintain communication by employer specified means with employees working in tanks to ensure their safety. The attendant may not enter any permit entry confined space to rescue an entrant or for any other reason, unless authorized by the rescue procedure and, and even then, only after calling the rescue team and being relieved by as attendant by another worker.

**Communications and observation.** Communications between attendant and entrant(s) shall be maintained throughout entry. Methods of communication that may be specified by the permit include voice, voice powered radio, tapping or rapping codes on tank walls, signalling tugs on a rope, and the attendant's observation that work activities such as chipping, grinding, welding, spraying, etc., which require deliberate operator control continue normally. These activities often generate so much noise that the necessary hearing protection makes communication by voice difficult.

**Rescue procedures.** Acceptable rescue procedures include entry by a team of employee-rescuers, use of public emergency services, and procedures for breaching the tank. The area permit specifies which procedures are available, but the area supervisor makes the final decision based on circumstances. (Certain injuries may make it necessary to breach the tank to remove a person rather than risk additional injury by removal through an existing manhole. However, the supervisor must ensure that no breaching procedure used for rescue would violate terms of the entry permit. For instance, if the tank must be breached by cutting with a torch, the tank surfaces to be cut must be free of volatile or combustible coatings within 4 inches (10.16 cm) of the cutting line and the atmosphere within the tank must be below the LFL.

**Retrieval line and harnesses.** The retrieval lines and harnesses generally required under this standard are usually impractical for use in tanks because the internal configuration of

the tanks and their interior baffles and other structures would prevent rescuers from hauling out injured entrants. However, unless the rescue procedure calls for breaching the tank for rescue, the rescue team shall be trained in the use of retrieval lines and harnesses for removing injured employees through manholes.

## **B. Repair or service of "used" tanks and bulk trailers.**

**Sources of hazards.** In addition to facing the potential hazards encountered in fabrication or manufacturing, tanks or trailers which have been in service may contain residues of dangerous materials, whether left over from the transportation of hazardous cargoes or generated by chemical or bacterial action on residues of non-hazardous cargoes.

**Control of atmospheric hazards.** A "used" tank shall be brought into areas where tank entry is authorized only after the tank has been emptied, cleansed (without employee entry) of any residues, and purged of any potential atmospheric hazards.

**Welding.** In addition to tank cleaning for control of atmospheric hazards, coating and surface materials shall be removed 4 inches (10.16 cm) or more from any surface area where welding or other torch work will be done and care taken that the atmosphere within the tank remains well below the LFL. (Follow the requirements of 29 CFR 1910, Subpart Q, OSHA's welding standard, at all times.)

**Permits.** An entry permit valid for up to 1 year shall be issued prior to authorization of entry into used tank trailers, dry bulk trailers or trucks. In addition to the pre-entry cleaning requirement, this permit shall require the employee safeguards specified for new tank fabrication or construction permit areas.

**Authorization.** Only the area supervisor may authorize an employee to enter a tank trailer, dry bulk trailer or truck within the permit area. The area supervisor must determine that the entry permit requirements have been met before authorizing entry.

## **APPENDIX D TO SEC. 1910.146--Sample Permits**

**Appendix D to §1910.146**  
**Confined Space Pre-Entry Check List**  
**Appendix D - 1**

Confined Space Entry Permit

Date and Time Issued: \_\_\_\_\_ Date and Time Expires: \_\_\_\_\_

Job site/Space I.D.: \_\_\_\_\_ Job Supervisor: \_\_\_\_\_

Equipment to be worked on: \_\_\_\_\_ Work to be performed: \_\_\_\_\_

Stand-by personnel: \_\_\_\_\_

1. Atmospheric Checks: Time \_\_\_\_\_  
 Oxygen \_\_\_\_\_ %  
 Explosive \_\_\_\_\_ % L.F.L.  
 Toxic \_\_\_\_\_ PPM

2. Tester's signature: \_\_\_\_\_

3. Source isolation (No Entry): N/A Yes No  
 Pumps or lines blinded, ( ) ( ) ( )  
 disconnected, or blocked ( ) ( ) ( )

4. Ventilation Modification: N/A Yes No  
 Mechanical ( ) ( ) ( )  
 Natural Ventilation only ( ) ( ) ( )

5. Atmospheric check after isolation and Ventilation:

Oxygen \_\_\_\_\_ % > 19.5 %

Explosive \_\_\_\_\_ % L.F.L. < 10 %

Toxic \_\_\_\_\_ PPM < 10 PPM H(2)S

Time: \_\_\_\_\_

Testers signature: \_\_\_\_\_

6. Communication procedures: \_\_\_\_\_

7. Rescue procedures: \_\_\_\_\_

8. Entry, standby, and back up persons: Yes No

Successfully completed required training? ( ) ( )  
 Is it current? ( ) ( )

9. Equipment: N/A Yes No  
 Direct reading gas monitor - tested ( ) ( ) ( )  
 Safety harnesses and lifelines for entry ( ) ( ) ( )  
 and standby persons ( ) ( ) ( )  
 Hoisting equipment ( ) ( ) ( )  
 Powered communications ( ) ( ) ( )  
 SCBA's for entry and standby persons ( ) ( ) ( )  
 Protective Clothing ( ) ( ) ( )  
 All electric equipment listed  
 Class I, Division I, Group D and  
 Non-sparking tools ( ) ( ) ( )

10. Periodic atmospheric tests:

Oxygen _____ %	Time _____	Oxygen _____ %	Time _____
Oxygen _____ %	Time _____	Oxygen _____ %	Time _____
Explosive _____ %	Time _____	Explosive _____ %	Time _____
Explosive _____ %	Time _____	Explosive _____ %	Time _____
Toxic _____ %	Time _____	Toxic _____ %	Time _____

We have reviewed the work authorized by this permit and the information contained here-in. Written instructions and safety procedures have been received and are understood. Entry cannot be approved if any squares are marked in the "No" column. This permit is not valid unless all appropriate items are completed.

Permit Prepared By: (Supervisor) \_\_\_\_\_  
 Approved By: (Unit Supervisor) \_\_\_\_\_  
 Reviewed By (Cs Operations Personnel) : \_\_\_\_\_  
 \_\_\_\_\_ (printed name) \_\_\_\_\_ (signature)

This permit to be kept at job site. Return job site copy to Safety Office following job completion.

Copies: White Original (Safety Office)  
 Yellow (Unit Supervisor)  
 Hard (Job site)

## Appendix D - 2

### ENTRY PERMIT

PERMIT VALID FOR 8 HOURS ONLY. ALL COPIES OF PERMIT WILL REMAIN AT JOB SITE UNTIL JOB IS COMPLETED

DATE: \_\_\_\_\_ SITE LOCATION and DESCRIPTION \_\_\_\_\_  
 PURPOSE OF ENTRY \_\_\_\_\_

SUPERVISOR(S) in charge of crews Type of Crew Phone# \_\_\_\_\_

COMMUNICATION PROCEDURES \_\_\_\_\_  
 RESCUE PROCEDURES (PHONE NUMBERS AT BOTTOM) \_\_\_\_\_

\* BOLD DENOTES MINIMUM REQUIREMENTS TO BE COMPLETED AND REVIEWED PRIOR TO ENTRY\*

REQUIREMENTS COMPLETED	DATE	TIME
Lock Out/De-energize/Try-out	_____	_____
Line(s) Broken-Capped-Blanked	_____	_____
Purge-Flush and Vent	_____	_____
Ventilation	_____	_____
Secure Area (Post and Flag)	_____	_____
Breathing Apparatus	_____	_____
Resuscitator - Inhalator	_____	_____
Standby Safety Personnel	_____	_____
Full Body Harness w/"D" ring	_____	_____
Emergency Escape Retrieval Equip	_____	_____
Lifelines	_____	_____
Fire Extinguishers	_____	_____
Lighting (Explosive Proof)	_____	_____
Protective Clothing	_____	_____
Respirator(s) (Air Purifying)	_____	_____
Burning and Welding Permit	_____	_____

Note: Items that do not apply enter N/A in the blank.

**\*\*RECORD CONTINUOUS MONITORING RESULTS EVERY 2 HOURS**

CONTINUOUS MONITORING**	Permissible	_____	_____	_____	_____	_____
TEST(S) TO BE TAKEN	Entry Level	_____	_____	_____	_____	_____
PERCENT OF OXYGEN	19.5% to 23.5%	_____	_____	_____	_____	_____
LOWER FLAMMABLE LIMIT	Under 10%	_____	_____	_____	_____	_____
CARBON MONOXIDE	+35 PPM	_____	_____	_____	_____	_____
Aromatic Hydrocarbon	+ 1 PPM * 5 PPM	_____	_____	_____	_____	_____
Hydrogen Cyanide	(Skin) * 4 PPM	_____	_____	_____	_____	_____
Hydrogen Sulfide	+10 PPM *15 PPM	_____	_____	_____	_____	_____
Sulfur Dioxide	+ 2 PPM * 5 PPM	_____	_____	_____	_____	_____
Ammonia	*35 PPM	_____	_____	_____	_____	_____

\* Short-term exposure limit: Employee can work in the area up to 15 minutes.

+ 8 hr. Time Weighted Avg.: Employee can work in area 8 hrs (longer with appropriate respiratory protection).

REMARKS: \_\_\_\_\_

GAS TESTER NAME & CHECK #	INSTRUMENT(S) USED	MODEL &/ OR TYPE	SERIAL &/OR UNIT #
_____	_____	_____	_____
_____	_____	_____	_____

**SAFETY STANDBY PERSON IS REQUIRED FOR ALL CONFINED SPACE WORK**

SAFETY STANDBY PERSON(S)	CHECK #	CONFINED SPACE ENTRANT(S)	CHECK #	CONFINED SPACE ENTRANT(S)	CHECK #
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

SUPERVISOR AUTHORIZING - ALL CONDITIONS SATISFIED \_\_\_\_\_  
DEPARTMENT/PHONE \_\_\_\_\_

AMBULANCE 2800      FIRE 2900      SAFETY 4901      GAS COORDINATOR 4529/5387

**APPENDIX E TO SEC. 1910.146—Sewer System Entry**

Sewer entry differs in three vital respects from other permit entries; first, there rarely exists any way to completely isolate the space (a section of a continuous system) to be entered; second, because isolation is not complete, the atmosphere may suddenly and unpredictably become lethally hazardous (toxic, flammable or explosive) from causes beyond the control of the entrant or employer, and third, experienced sewer workers are especially knowledgeable in entry and work in their permit spaces because of their frequent entries. Unlike other employments where permit space entry is a rare and exceptional event, sewer workers' usual work environment is a permit space.

**(1) Adherence to procedure.** The employer should designate as entrants only employees who are thoroughly trained in the employer's sewer entry procedures and who demonstrate that they follow these entry procedures exactly as prescribed when performing sewer entries.

**(2) Atmospheric monitoring.** Entrants should be trained in the use of, and be equipped with, atmospheric monitoring equipment which sounds an audible alarm, in addition to its visual readout, whenever one of the following conditions are encountered: Oxygen concentration less than 19.5 percent; flammable gas or vapor at 10 percent or more of the lower flammable limit (LFL); or hydrogen sulfide or carbon monoxide at or above 10 ppm or 35 ppm, respectively, measured as an 8-hour time-weighted average. Atmospheric monitoring equipment needs to be calibrated according to the manufacturer's instructions. The oxygen sensor/broad range sensor is best suited for initial use in situations where the actual or potential contaminants have not been identified, because broad range sensors, unlike substance-specific sensors, enable employers to obtain an overall reading of the hydrocarbons (flammables) present in the space. However, such sensors only indicate that a hazardous threshold of a class of chemicals has been exceeded. They do not measure the levels of contamination of specific substances. Therefore, substance-specific devices, which measure the actual levels of specific substances, are best suited for use where actual and potential contaminants have been identified. The measurements obtained with substance-specific

devices are of vital importance to the employer when decisions are made concerning the measures necessary to protect entrants (such as ventilation or personal protective equipment) and the setting and attainment of appropriate entry conditions. However, the sewer environment may suddenly and unpredictably change, and the substance-specific devices may not detect the potentially lethal atmospheric hazards which may enter the sewer environment.

Although OSHA considers the information and guidance provided above to be appropriate and useful in most sewer entry situations, the Agency emphasizes that each employer must consider the unique circumstances, including the predictability of the atmosphere, of the sewer permit spaces in the employer's workplace in preparing for entry. Only the employer can decide, based upon his or her knowledge of, and experience with permit spaces in sewer systems, what the best type of testing instrument may be for any specific entry operation.

The selected testing instrument should be carried and used by the entrant in sewer line work to monitor the atmosphere in the entrant's environment, and in advance of the entrant's direction of movement, to warn the entrant of any deterioration in atmospheric conditions. Where several entrants are working together in the same immediate location, one instrument, used by the lead entrant, is acceptable.

**(3) Surge flow and flooding.** Sewer crews should develop and maintain liaison, to the extent possible, with the local weather bureau and fire and emergency services in their area so that sewer work may be delayed or interrupted and entrants withdrawn whenever sewer lines might be suddenly flooded by rain or fire suppression activities, or whenever flammable or other hazardous materials are released into sewers during emergencies by industrial or transportation accidents.

**(4) Special Equipment.** Entry into large bore sewers may require the use of special equipment. Such equipment might include such items as atmosphere monitoring devices with automatic audible alarms, escape self-contained breathing apparatus (ESCBA) with at least 10 minute air supply (or other NIOSH approved self-rescuer), and waterproof flashlights, and may also include boats and rafts, radios and rope stand-offs for pulling around bends and corners as needed.

**APPENDIX F TO SEC. 1910.146--Rescue Team or Rescue Service Evaluation Criteria (Non-Mandatory)**

(1) This appendix provides guidance to employers in choosing an appropriate rescue service. It contains criteria that may be used to evaluate the capabilities both of prospective and current rescue teams. Before a rescue team can be trained or chosen, however, a satisfactory permit program, including an analysis of all permit-required confined spaces to identify all potential hazards in those spaces, must be completed. OSHA believes that compliance with all the provisions of Sec. 1910.146 will enable employers to conduct permit space operations without recourse to rescue services in nearly all cases. However, experience indicates that circumstances will arise where entrants will need to be rescued from permit spaces. It is therefore important for employers to select rescue services or teams, either on-site or off-site, that are equipped and capable of minimizing harm to both entrants and rescuers if the need arises.

(2) For all rescue teams or services, the employer's evaluation should consist of two components: an initial evaluation, in which employers decide whether a potential rescue service or team is adequately trained and equipped to perform permit space rescues of the kind needed at the facility and whether such rescuers can respond in a timely manner, and a performance evaluation, in which employers measure the performance of the team or service during an actual or practice rescue. For example, based on the initial evaluation, an employer may determine that maintaining an on-site rescue team will be more expensive than obtaining the services of an off-site team, without being significantly more effective, and decide to hire a rescue service. During a performance evaluation, the employer could decide, after observing the rescue service perform a practice rescue, that the service's training or preparedness was not adequate to effect a timely or effective rescue at his or her facility and decide to select another rescue service, or to form an internal rescue team.

**A. Initial Evaluation**

I. The employer should meet with the prospective rescue service to facilitate the evaluations required by Sec. 1910.146(k)(1)(i) and Sec. 1910.146(k)(1)(ii). At a minimum, if an off-site

rescue service is being considered, the employer must contact the service to plan and coordinate the evaluations required by the standard. Merely posting the service's number or planning to rely on the 911 emergency phone number to obtain these services at the time of a permit space emergency would not comply with paragraph (k)(1) of the standard.

II. The capabilities required of a rescue service vary with the type of permit spaces from which rescue may be necessary and the hazards likely to be encountered in those spaces. Answering the questions below will assist employers in determining whether the rescue service is capable of performing rescues in the permit spaces present at the employer's workplace.

1. What are the needs of the employer with regard to response time (time for the rescue service to receive notification, arrive at the scene, and set up and be ready for entry)? For example, if entry is to be made into an IDLH atmosphere, or into a space that can quickly develop an IDLH atmosphere (if ventilation fails or for other reasons), the rescue team or service would need to be standing by at the permit space. On the other hand, if the danger to entrants is restricted to mechanical hazards that would cause injuries (e.g., broken bones, abrasions) a response time of 10 or 15 minutes might be adequate.

2. How quickly can the rescue team or service get from its location to the permit spaces from which rescue may be necessary? Relevant factors to consider would include: the location of the rescue team or service relative to the employer's workplace, the quality of roads and highways to be traveled, potential bottlenecks or traffic congestion that might be encountered in transit, the reliability of the rescuer's vehicles, and the training and skill of its drivers.

3. What is the availability of the rescue service? Is it unavailable at certain times of the day or in certain situations? What is the likelihood that key personnel of the rescue service might be unavailable at times? If the rescue service becomes unavailable while an entry is underway, does it have the capability of notifying the employer so that the employer can instruct the attendant to abort the entry immediately?

4. Does the rescue service meet all the requirements of paragraph (k)(2) of the standard? If not, has it developed a plan that will enable it

meet those requirements in the future? If so, how soon can the plan be implemented?

5. For off-site services, is the service willing to perform rescues at the employer's workplace? (An employer may not rely on a rescuer who declines, for whatever reason, to provide rescue services.)

6. Is an adequate method for communications between the attendant, employer and prospective rescuer available so that a rescue request can be transmitted to the rescuer without delay? How soon after notification can a prospective rescuer dispatch a rescue team to the entry site?

7. For rescues into spaces that may pose significant atmospheric hazards and from which rescue entry, patient packaging and retrieval cannot be safely accomplished in a relatively short time (15-20 minutes), employers should consider using airline respirators (with escape bottles) for the rescuers and to supply rescue air to the patient. If the employer decides to use SCBA, does the prospective rescue service have an ample supply of replacement cylinders and procedures for rescuers to enter and exit (or be retrieved) well within the SCBA's air supply limits?

8. If the space has a vertical entry over 5 feet in depth, can the prospective rescue service properly perform entry rescues? Does the service have the technical knowledge and equipment to perform rope work or elevated rescue, if needed?

9. Does the rescue service have the necessary skills in medical evaluation, patient packaging and emergency response?

10. Does the rescue service have the necessary equipment to perform rescues, or must the equipment be provided by the employer or another source?

#### B. Performance Evaluation

Rescue services are required by paragraph (k)(2)(iv) of the standard to practice rescues at least once every 12 months, provided that the team or service has not successfully performed a permit space rescue within that time. As part of each practice session, the service should perform a critique of the practice rescue, or have another qualified party perform the critique, so that deficiencies in procedures, equipment, training, or number of personnel can be identified and corrected. The results of the critique, and the corrections made to respond to the deficiencies identified, should be given to the employer to

enable it to determine whether the rescue service can quickly be upgraded to meet the employer's rescue needs or whether another service must be selected. The following questions will assist employers and rescue teams and services evaluate their performance.

1. Have all members of the service been trained as permit space entrants, at a minimum, including training in the potential hazards of all permit spaces, or of representative permit spaces, from which rescue may be needed? Can team members recognize the signs, symptoms, and consequences of exposure to any hazardous atmospheres that may be present in those permit spaces?

2. Is every team member provided with, and properly trained in, the use and need for PPE, such as SCBA or fall arrest equipment, which may be required to perform permit space rescues in the facility? Is every team member properly trained to perform his or her functions and make rescues, and to use any rescue equipment, such as ropes and backboards, that may be needed in a rescue attempt?

3. Are team members trained in the first aid and medical skills needed to treat victims overcome or injured by the types of hazards that may be encountered in the permit spaces at the facility?

4. Do all team members perform their functions safely and efficiently? Do rescue service personnel focus on their own safety before considering the safety of the victim?

5. If necessary, can the rescue service properly test the atmosphere to determine if it is IDLH?

6. Can the rescue personnel identify information pertinent to the rescue from entry permits, hot work permits, and MSDSs?

7. Has the rescue service been informed of any hazards to personnel that may arise from outside the space, such as those that may be caused by future work near the space?

8. If necessary, can the rescue service properly package and retrieve victims from a permit space that has a limited size opening (less than 24 inches (60.9 cm) in diameter), limited internal space, or internal obstacles or hazards?

9. If necessary, can the rescue service safely perform an elevated (high angle) rescue?

10. Does the rescue service have a plan for each of the kinds of permit space rescue operations at the facility? Is the plan adequate for all types of rescue operations that may be

needed at the facility? Teams may practice in representative spaces, or in spaces that are "worst-case" or most restrictive with respect to internal configuration, elevation, and portal size.

The following characteristics of a practice space should be considered when deciding whether a space is truly representative of an actual permit space:

**1) Internal configuration.**

(a) Open--there are no obstacles, barriers, or obstructions within the space. One example is a water tank.

(b) Obstructed--the permit space contains some type of obstruction that a rescuer would need to maneuver around. An example would be a baffle or mixing blade. Large equipment, such as a ladder or scaffold, brought into a space for work purposes would be considered an obstruction if the positioning or size of the equipment would make rescue more difficult.

**(2) Elevation.**

(a) Elevated--a permit space where the entrance portal or opening is above grade by 4 feet or more. This type of space usually requires knowledge of high angle rescue procedures because of the difficulty in packaging and transporting a patient to the ground from the portal.

(b) Non-elevated--a permit space with the entrance portal located less than 4 feet above grade. This type of space will allow the rescue team to transport an injured employee normally.

**(3) Portal size.**

(a) Restricted--A portal of 24 inches or less in the least dimension. Portals of this size are too small to allow a rescuer to simply enter the space while using SCBA. The portal size is also too small to allow normal spinal immobilization of an injured employee.

(b) Unrestricted--A portal of greater than 24 inches in the least dimension. These portals allow relatively free movement into and out of the permit space.

**(4) Space access.**

(a) Horizontal--The portal is located on the side of the permit space. Use of retrieval lines could be difficult.

(b) Vertical--The portal is located on the top of the permit space, so that rescuers must climb down, or the bottom of the permit space, so that rescuers must climb up to enter the space. Vertical portals may require knowledge of rope techniques, or special patient packaging to safely retrieve a downed entrant.

[58 FR 4549, Jan. 14, 1993; 58 FR 34845, 34846, June 29, 1993, as amended at 59 FR 26114, May 19, 1994; 63 FR 66038, 66039, Dec. 1, 1998]





# HAZARDOUS WASTE WORKER

Section

## GLOSSARY

Title

### A

**Access control point** - Exit and entry points at the boundary of the exclusion zone where the flow of equipment and personnel are regulated into and out of the exclusion zone.

**Accident** - An undesirable, unplanned event resulting in personal physical harm, damage to property, or interruption of business.

**ACGIH** - American Conference of Governmental Industrial Hygienists

**Acute exposure** - A single short exposure, or a few short exposures, usually to a relatively large concentration of a chemical or energy source, such as noise, radiation, or heat.

**Administrative controls** - Exposure control measures that reduce exposure to an acceptable limit by scheduling reduced work times in contaminated areas and establishing work rules.

**Administrative order** - A legal document signed by EPA directing an individual, business, or other entity to take corrective action or refrain from an activity.

**Administrative order on consent** - A legal agreement signed by EPA and an individual, business, or other entity through which the violator agrees to pay for correction of violations, take the required corrective or clean-up actions, or refrain from an activity.

**Administrative record** - The official, government controlled record of all documents that pertain to the selection of a response action or the conduct of an administrative hearing.

**AFL** - American Federation of Labor

**AFL-CIO** - American Federation of Labor-Congress of Industrial Organizations

**ASHERA** - Asbestos Hazard Emergency Response Act

**ANSI** - American National Standards Institute

**Applicable or relevant and appropriate requirements** - Federal standards and more stringent state standards that are legally applicable or relevant and appropriate under the circumstances. ARARs include cleanup standards, standards of control, and other environmental protection requirements, criteria, or limitations.

**APR** - Air purifying respirator

**Aquifer** - A geologic formation composed of permeable rock or loose material that can store, transmit, and yield a usable supply of water.

**ARAR** - Applicable or Relevant and Appropriate Requirements

**ASME** - American Society of Mechanical Engineers

**Asphyxiant** - A substance that can cause oxygen deficiency in the blood and can lead to loss of consciousness, serious injury, or death. There are two types of asphyxiants—simple and chemical.

**ATSDR** - Agency for Toxic Substances and Disease Registry

**Attendant** - A worker who remains outside the confined space while work is being done inside.

## Glossary

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### B

**BAC** - Breath alcohol concentration

**Base** - A substance which turns litmus blue, produces hydroxyl ions in water solutions, and reacts with acids to form water and salts.

**Bioassay** - Process of evaluating body samples (e.g., nails, hair, urine) to determine the presence of chemicals or radiation in the body.

**Blanking (or blinding)** - The absolute closure of a pipe, line, or duct by the fastening of a solid plate that completely covers the bore and is capable of withstanding the maximum pressure of the pipe, line, or duct.

**Blinding** - (see Blanking)

**Breakthrough** - The point at which chemicals begin to pass through a respirator filter because the filter's saturation point has been reached.

**Bridging** - A condition that occurs when grain, or a similar loose material, clings to the sides of a container or vessel that is being emptied from below. A hollow space is created with an unstable covering of grain over it.

**Bulking** - The process of mixing identified wastes and packing them in bulk containers (e.g., tank trailers or vacuum truck) for shipping to treatment or disposal facilities.

### C

**C** - Ceiling limit

**C°** - Celsius or centigrade

**Calibration gas** - A reference gas used to adjust the settings on an air monitoring instrument to known measurements.

**Carcinogens** - Substances that cause cancer.

**Caustic** - Alkali that strongly irritates, burns, corrodes, or destroys living tissue.

**Ceiling limit** - Exposure level for a substance that must never be exceeded.

**CCA** - Chromated copper arsenate

**CERCLA** - Comprehensive Environmental Response Compensation and Liability Act (commonly known as Superfund)

**CERCLIS** - Comprehensive Environmental Response, Compensation, and Liability Information System

**CFR** - Code of Federal Regulations

**CGI** - Combustible gas indicator

**CG/OI** - Combustible gas and oxygen indicator

**Chain of custody** - Process that documents each person who handles a groundwater sample, from the time of collection to laboratory analysis.

**Characterization** - The process in which material sampling is used to identify the chemical composition of unknown or potentially hazardous materials.

**Chemical reaction** - A chemical change that occurs when chemicals combine with each other to produce a new substance and release of energy.

**Chronic exposure** - A repeated exposure that occurs over months and years, usually at relatively low concentrations of a chemical.

**Cleanup or clean-up operation** - Actions taken to deal with a release or threat of a hazardous substance that could affect people or the environment. The term "cleanup" is sometimes used interchangeably with the terms remedial action, removal action, response action, remedy, remediation, or corrective action.

**Combustible material** - Any liquid with a flash point between 100°F and 1500°F (37.8°C and 815.6°C). (DOT)

**Compatible** - Chemicals that can exist in close and permanent association with each other without creating a hazard.

**Comprehensive Environmental Response, Compensation, and Liability Information System** - A data base maintained by EPA which lists sites where releases have either been addressed or need to be addressed.

**Condensation** - The process by which a gas or vapor is changed to a liquid (or solid).

**Confined space** - Any area with the following characteristics: adequate size and shape to allow a person to enter; limited opening for workers to enter and exit; and not designed for continuous human occupancy.

**Confined space permit** - An authorization form that is the primary source of information for hazards found in a permit-required confined space and their controls.

**Consent decree** - A legal document that specifies your obligations when you enter into a settlement with the government.

**Contaminant plume** - The area of contamination occupied by a leachate that moves through the groundwater and grows over time.

**Contaminant reentrainment** - When external contaminants are drawn into a confined space during the process of ventilation by placing a fresh air intake too close to a source of contamination.

**Contamination reduction corridor** - Designated area within the contamination reduction zone that provides passage for workers and equipment from the support zone to the exclusion zone. It is the area where decontamination procedures take place.

**Contamination reduction zone** - The zone, located between the exclusion zone and the support zone, that provides a transition between the contaminated and clean areas.

**Controlled access zone** - An area in which certain work may take place without the use of guardrail systems, personal fall arrest systems, or safety net systems. Entry to the zone is controlled.

**Corrosive chemical** - Any solid, liquid, or gaseous substance that attacks building materials or metals or that burns, irritates, or destructively attacks organic tissue, most notably the skin and when taken internally the lungs and stomach.

**CPC** - Chemical protective clothing

**CPE** - Chlorinated polyethylene

**CPR** - Cardiopulmonary resuscitation

**CRC** - Contamination reduction corridor

**CRP** - Community Relations Plan

**CRZ** - Contamination reduction zone

**CTD** - Cumulative trauma disorders

**CWA** - Clean Water Act

## D

**dB** - Decibels

**DDD** - dichlorodiphenyldichloroethane

**DDE** - dichlorodiphenyldichloroethylene

**DDT** - dichlorodiphenyltrichloroethane

**Decontamination** - Process of removing or neutralizing chemicals that have accumulated on PPE, tools, or equipment used on the job.

**Degradation** - The process by which a chemical changes a protective material so that the protective material loses some of its effectiveness as a barrier.

**Delayed effect** - A health effect that takes a long time to develop, usually the result of repeated exposures to low doses of a substance over a long period of time.

**Dermatitis** - Skin irritation with symptoms such as red, itchy skin, swelling, ulcers, and blisters.

## Glossary

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**DHHS** - Department of Health and Human Services

**DOD** - Department of Defense

**DOE** - Department of Energy

**Doffing** - The act of removing PPE.

**Donning** - The act of putting on PPE.

**DOP** - Dioctyl phthalate

**Dose** - The amount or concentration of a substance a person receives over a specific period of time.

**DOT** - Department of Transportation

**Double block and bleed** - A system of closing off a pipe using a T-configuration. Two valves block off materials and one valve bleeds the pipe. It's used to isolate a confined space.

**Double purge** - The process of ventilating a confined space with breathable air after it has been inerted.

**Downgradient** - A low pressure area found underground.

**DRI** - Direct reading instruments

**DWI** - Driving while intoxicated

**Ensemble** - The term used for a whole outfit of protective equipment, usually a specific pairing of a respirator with a type of protective clothing.

**Entrant** - A worker who enters the confined space to work.

**Entry supervisor** - The person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by the regulations.

**EPA** - Environmental Protection Agency

**ESLI** - End of service life indicator

**Evaporation** - The process by which a liquid (or solid) is change to a gas or vapor.

**Exclusion zone** - The area where hazardous waste clean-up work takes place and contamination occurs.

**Exhaust system** - A system, that pulls air from a confined space using fans or fume hoods.

**Ex situ** - Removed from the original location. A remediation technology applied ex situ means soil or air is removed from its original location and treated elsewhere.

## E

**EAP** - Employee Assistance Program

**ECG or EKG** - Electrocardiogram

**Energy-isolating device** - A mechanism that prevents the release of energy or materials.

**Engineering controls** - Exposure control measure that reduces or eliminates exposures by using mechanical means, such as ventilation systems, acoustical material, and clean air control booths. This measure doesn't eliminate the hazard.

## F

**Facility** - Under CERCLA (1) any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, landfill, storage container, motor vehicle, rolling stock, or aircraft; or (2) any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or has otherwise come to be located.

**Feasibility study** - A study that uses data generated by the remedial investigation to identify and evaluate alternative remedial clean-up actions.

**FEOSH** - Federal Employee Occupational Safety and Health

**FID** - Flame ionization detector

**First-break** - The initial disconnection or breaking of the pipeline.

**Flame ionization detector** - A portable instrument used to detect organic compounds.

**Flammable atmosphere** - An atmosphere resulting from vaporization of flammable liquids, by-products of chemical reaction, or concentrations of combustible dusts.

**Flammable material** - Any liquid having a flash point below 100°F (37.8°C). (DOT)

**Flammable range** - The concentrations between the lower flammability limit and the upper flammability limit.

**Flash point** - The lowest temperature at which a material gives off enough vapors to form an ignitable mixture with the air.

**FM** - Factory Mutual

**FS** - Feasibility study

## G

**Gastrointestinal tract** - The stomach and intestines

**GC** - Gas chromatograph

**GC/MS** - Gas chromatography-mass spectrometry

**General ventilation** - The process of ventilating the entire confined space.

**Groundwater** - The water filling the spaces, voids, and cracks of the saturated zone.

## H

**Hazard** - Any condition, situation, or agent that has the potential to produce an undesirable effect.

**Hazard Ranking System** - A number-based scoring system that evaluates the relative risks to human health and welfare and the environment posed by uncontrolled hazardous waste sites. EPA uses the score to determine which sites should be listed on the National Priorities List.

**Hazardous atmosphere** - An atmosphere which contains one or more of the following hazards: oxygen deficiency/oxygen enrichment, flammable atmosphere, or toxic air contaminants.

**Hazardous substances** - Any substances or materials that in normal use (e.g. processing plant work, manufacturing, and chemical decontamination on hazardous work sites) can be damaging to the health and well-being of workers or the environment.

**Hazardous Substance Superfund** - A trust fund that provides operating money for government-financed actions under CERCLA.

**Hazardous waste** - A hazardous substance that has been discarded or otherwise designated as a waste material.

**HazMat** - Hazardous Materials

**HEPA filter** - High efficiency particulate air filter

**High efficiency particulate air filter** - A filter capable of capturing 99.97% of the particles pulled through it.

**HMIS** - Hazardous materials identification system

**Hot line** - Outer boundary of the exclusion zone.

## Glossary

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**Hot zone** - Common name for the exclusion zone.

**HRS** - Hazard Ranking System

**HSIF** - Hazardous substance information form

**HSWA** - Hazardous and solid waste amendments.

### I

**IAA** - Isoamyl acetate

**ICAO** - International Civil Aviation Organization

**IDLH** - Immediately dangerous to life and health

**Immediately dangerous to life or health** - An exposure level in an environment likely to cause death or serious health effects with very short exposures.

**Incompatible** - Chemicals that react together and result in a hazard.

**Inerting** - The process of removing oxygen from a confined space by introducing a nonreactive gas to reduce the flammable mixture of fuel and oxygen so that ignition or combustion is not possible.

**Ingestion** - 1. The act of taking food and other substances into the body by the mouth. 2. A route of entry into the body along with food or water, or through inhalation and then swallowing.

**Inhalation** - 1. The act of breathing in a substance in the form of a gas, vapor, fume, mist, or dust. 2. A route of entry into the body for microorganisms, chemicals, or physical agents during breathing.

**In-situ** - In the natural or original place. A remediation technology applied in situ means the soil or water is treated in place.

**Insoluble** - Cannot be dissolved

**Interaction** - A condition that occurs when exposure to more than one substance results in a health effect different from the effects of either one alone. There are two types of interaction: synergism and potentiation.

**Isolation** - The process by which a space is removed from service and completely protected against the release of energy and material into the space.

### L

**Laboratory pack** - Drum containing individual containers of laboratory materials normally surrounded by cushioning and absorbent material. Also called a lab pack.

**Latency period** - The time period between the first exposure and the appearance of disease caused by the exposure.

**Leachate** - Solution formed when wastes or contaminants are dissolved in water.

**Lead agency** - The federal or state agency providing the On-Scene Coordinator (OSC) for a removal action or the responsible official for a CERCLA response action.

**LEL** - Lower explosion limit

**LFL** - Lower flammability limit

**Line-breaking** - The term used for the intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic materials; inert gases; or any fluids at a volume, pressure, or temperature that is capable of causing injury.

**LIUNA** - Laborers' International Union of North America

**Local effect** - The health effect that occurs at the location where a chemical comes in contact with the body.

**Local exhaust** - The process of removing contaminants at their source.

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**M**

**Macrophage** - A large white blood cell that ingests microorganisms or other cells and foreign particles that enter the body.

**MAP** - Membership Assistance Program

**Material safety data sheet** - The primary source of information for hazardous chemicals used on a hazardous waste work site.

**Maximum use concentration** - The highest concentration of a specific contaminant for which a cartridge or canister provides approved protection.

**Maximum use level** - The level of a specific contaminant that, if exceeded, will cause a worker to be exposed above the PEL because of leakage in a respirator.

**Mechanical ventilation** - The use of blowers or fans and ducts to ventilate a confined space.

**Metabolites** - By-products (what is left behind) of drugs as they pass through the body.

**mg/m<sup>3</sup>** - milligrams per cubic meter

**MRO** - Medical review officer

**MSDS** - Material safety data sheet

**MSHA** - Mine Safety and Health Administration

**MUC** - Maximum use concentration

**MUL** - Maximum use level

**Mutagenic effect** - A permanent mutation or change to the genes and chromosomes in the female ovum or male sperm. A mutagenic effect can cause birth defects.

**N**

**National Contingency Plan** - The basic policy directive for federal response actions under CERCLA.

**National Priorities List** - A list of sites designated as needing long term remedial cleanup whose purpose is to inform the public of the most serious hazardous waste sites in the nation.

**NBAR** - Nonbinding preliminary allocation of responsibility

**NCP** - National Contingency Plan

**NESHAP** - National Emission Standards for Hazardous Air Pollutants

**NFPA** - National Fire Protection Association

**ng** - nanograms

**NIDA** - National Institute for Drug Abuse

**NIOSH** - National Institute of Occupational Safety and Health

**NPL** - National Priorities List

**NPS** - Nonpoint source

**NRC** - 1. Nuclear Regulatory Commission  
2. National Response Center

**NRR** - Noise reduction rating

**O**

**Occurrence** - Any event or accident that is a deviation from planned or expected behavior or events, such as an injury or death, involvement with nuclear explosives, accidental release of pollutants, or accidental release of radioactive material above regulatory limit.

**Olfactory fatigue** - Condition that occurs when the sense of smell is dulled from a chemical exposure.

## Glossary

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**On-scene coordinator** - Under the NCP, a representative of EPA or the state who directs or coordinates operations at the scene of a removal action.

**Operable unit** - Separate response measures, consistent with a permanent remedy, but not the entire permanent remedy itself.

**Operation and maintenance** - Activities conducted at a site after a Superfund site remedial action is completed to ensure that the remedy is effective and operating properly.

**Organic compound** - A chemical compound containing carbon.

**OSC** - On-scene coordinator

**OSHA** - Occupational Safety and Health Administration

**OSH Act** - Occupational Safety and Health Act

**OVA** - Organic vapor analyzer.

**Over breathing** - When, under heavy work conditions, a worker uses more air than a PAPR can provide, creating negative pressure in the mask.

**Oxidizing material** - Material that initiates or supports combustion in another material, causing fire either by itself or through the release of oxygen or other gases.

**Oxygen-deficient atmosphere** - As defined by OSHA, an atmosphere that contains less than 19.5% oxygen by volume. This atmosphere cannot support life.

**Oxygen displacement** - Condition that occurs when a gas is introduced into an area, such as a confined space, and it pushes the oxygen out to make room for itself.

**Oxygen-enriched atmosphere** - As defined by OSHA, an atmosphere that contains more than 23.5% oxygen by volume. This atmosphere is a serious fire hazard.

## P

**PA** - Preliminary assessment

**PAPR** - Powered air purifying respirator

**PCB** - Polychlorinated biphenyl

**PDS** - Personnel decontamination station

**PEL** - Permissible exposure limit

**Penetration** - The process of a chemical passing through a garment by way of openings in the material, such as zippers and seams.

**Permeation** - The process by which a chemical moves through protective clothing on a molecular level.

**Permissible exposure limit** - Exposure guidelines for airborne concentrations of regulated substances that set limits upon a worker's inhalation exposure (the amount of substance a worker can safely breath).

**Permit-required confined space** - A confined space that contains or has the potential to contain a hazardous atmosphere, contains a material that has the potential for engulfing the entrant, has an internal configuration which could trap or asphyxiate an entrant by inwardly converging walls or by a floor which slopes downward to a smaller cross-section, or contains any other recognized serious hazard.

**Persistence** - The ability of a contaminant to remain in the soil and be degraded slowly by the environment.

**Personal protective equipment** - Any protective clothing or device used to prevent contact with and exposure to chemical and nonchemical hazards in the work place.

**PF** - Protection factor

**PFT** - Pulmonary function test

**pH** - potential of hydrogen

**Photoionization detector** - A portable instrument used to detect many organic and a few inorganic compounds.

**pH scale** - A scale, from 0-14, that shows a chemical's corrosive strength.

**PID** - Photoionization detector

**ppb** - parts per billion

**PPE** - Personal protective equipment

**ppm** - parts per million

**Poor warning properties** - Absence of odor, taste, or other trait which warns about a chemical's presence.

**Potentially responsible parties** - Parties identified by EPA as potentially liable under CERCLA for clean-up costs. PRPs may include generators and present or former owners/operators of certain facilities or real property where hazardous wastes have been stored, treated, or disposed of, as well as those who accepted hazardous waste for transport and selected the facility.

**Potentialiation** - A type of chemical reaction in which an effect of one substance is increased by exposure to a second substance that would not cause the effect by itself.

**Precipitation** - Drops of water (rain) or ice particles (snow) that condense from the atmospheric water vapor and fall to the surface of the earth.

**Pre-entry atmospheric testing** - Testing performed from the outside of a confined space to identify hazardous conditions within the confined space.

**Preliminary assessment** - A review of available information and a reconnaissance visit to a site to determine if it requires additional investigation or action.

**Prompt effect** - A health effect that is seen quickly, usually after an exposure to a high concentration of a hazardous material.

**Protection factor** - The rating assigned to a respirator or class of respirators that represents the level of protection it provides.

**PRP** - Potentially responsible party

**psi** - pounds per square inch

**PTA** - Parent Teacher Association

**Pulmonary edema** - Fluid build up in the lungs that causes shortness of breath and, if severe enough, death.

**Purging** - The process of replacing or diluting flammable vapors in a confined space by introducing air, steam, or water.

**PVA** - Polyvinyl alcohol

**PVC** - Polyvinyl chloride

## Q

**QLFT** - Qualitative fit testing

**QNFT** - Quantitative fit testing

**Qualitative fit test** - A test that determines respirator fit and involves introducing a harmless, odorous, or irritating substance into the breathing zone of the wearer.

**Quality Assurance/Quality Control** - A system of procedures, checks, audits, and corrective actions to ensure that all research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality.

**Quantitative fit test** - A sophisticated type of fit test that measures the actual amount of leakage into the respirator.

## Glossary

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### R

**RA** - Remedial action

**Radiation** - Energy emitted from radioactive materials in the form of particles or waves.1-20

**RAP** - Remedial action plan

**RCRA** - Resource Conservation and Recovery Act

**RD** - Remedial design

**Record of Decision** - A document identifies the remedial alternative chosen by EPA for implementation at a Superfund site. It is published by the government after completion of an remedial investigation and feasibility study and is part of the written administrative record.

**REL** - Recommended exposure level (NIOSH).

**Remedial action** - The actual work of cleaning up a hazardous waste site which has the following characteristics: (1) Normally lasts a long period of time (months to years), (2) Begins after the more immediate/emergency problems have been controlled, (3) Involves getting rid of hazardous materials and restoring the site to a normal condition.

**Remedial design** - The process of preparing the technical drawings, specifications, and other supporting documents on the site's remedial action.

**Remedial investigation** - The first part of the site remediation process that determines the nature and extent of contamination at a site.

**Remedial project manager** - An individual, designated within an EPA region, who directs federal fund-financed remedial actions and coordinates all other federal actions at the scene. The counterpart of the On-Scene Coordinator for removal actions.

**Removal, Remove, or Removal Action** - The response to any release or substantial threat of release of any hazardous substance or

contaminant that may present an imminent and substantial danger to public health and welfare.

**Response Action** - Any remedial action, removal action, or cleanup at a site under CERCLA. Includes enforcement-related activities.

**RI** - Remedial investigation

**Risk Assessment** - A qualitative and quantitative evaluation performed to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific pollutants. Baseline risk assessments are performed as part of the remedial investigation/feasibility study.

**ROD** - Record of decision

**RPM** - Remedial project manager

### S

**Saddle vent** - A piece of equipment connected to the duct work at the opening of a confined space that makes the duct narrower. It provides more room for workers to enter and exit the confined space.

**Safety** - The state of being secure from hurt, injury, or loss.

**SARA** - Superfund Amendments and Reauthorization Act

**Saturated zone** - The area below the water table containing spaces, voids, and cracks filled with water (groundwater).

**SCBA** - Self-contained breathing apparatus

**Sensitizer** - A chemical that can cause an allergic response in the body.

**S&HO** - Safety and Health Officer

**Shock sensitive chemicals** - chemicals that may explode if subjected to friction, heat, or shock

**Short term exposure limit** - Maximum concentration level of a substance to which workers can be exposed for a short period of time (usually 10 to 15 minutes) without suffering from adverse health effects.

**SI** - Site inspection

**Simple asphyxiating atmosphere** - An atmosphere that contains a gas or gases, which are nonreactive and nontoxic. In sufficient quantities, the gas(es) displace the oxygen and make the atmosphere unfit for respiration.

**Site inspection** - The process of collecting information from a Superfund site to determine the extent and severity of hazards posed by the site. It follows and is more extensive than a preliminary assessment

**Site safety and health plan** - A site-specific plan that establishes the policies and procedures necessary to protect workers and the public from possible hazards at the site.

**SLM** - Sound level meter

**Solubility** - The ability of one substance to dissolve in another substance.

**SOP** - Standard operating procedure

**Sorbent** - Granular material in a respirator cartridge or canister that absorbs specific contaminants from the air as the air is inhaled.

**Sorption** - To take up and hold, as by absorption or adsorption.

**Standard operating procedure** - Required procedures for performing the variety of work associated with activities at a hazardous waste site.

**STEL** - Short-term exposure limit

**Substitution** - Exposure control measure that eliminates a hazardous chemical by replacing it with a nonhazardous or less hazardous chemical that works as well. This control measure is the most desirable.

**Supply system** - A system that supplies fresh air by pushing air into a space using blowers or natural air movement.

**Support zone** - Outermost part of a hazardous waste site which is considered clean (uncontaminated).

**SVE** - soil vapor extraction

**SWDA** - Solid Waste Disposal Act (RCRA predecessor)

**SWMU** - Solid Waste Management Unit

**Synergism** - A chemical reaction in which two chemicals produce an effect that is greater than both of their effects put together.

**Systemic effect** - A health effect that occurs in the body at some place other than the point of contact.

## T

**TAG** - Technical assistance grant

**Target organs** - An organ or system affected by a chemical.

**TCE** - Trichloroethylene

**Teratogenic effect** - Damage to the developing embryo of a pregnant woman from her direct exposure to a chemical. Teratogenic effects can result in birth defects.

**Time weighted average** - Average concentration of a substance in an area over an 8-hour work shift of a 40-hour work week.

**TLV** - Threshold limit values

**Toxic chemical** - A substance that has poisonous or deadly effects on the body when it's inhaled, ingested, absorbed, or comes in contact with the skin.

**TSCA** - Toxic Substances Control Act

## Glossary

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**TSD facility** - Treatment, storage, disposal. A facility that treats, stores, and/or disposes of hazardous wastes. It is regulated under RCRA.

**TWA** - Time weighted average

### U

**UEL** - Upper explosion limit

**UFL** - Upper flammability limit

**UHF** - Ultra high frequency

**UHWM** - Uniform Hazardous Waste Manifest

**UL** - Underwriters Laboratories

**Unsaturated zone** - The layer of material above the water table that is made up of soil and rock particles. The spaces between these particles are filled with air and water.

**Upgradient** - A high pressure area found underground.

**UST** - Underground storage tank

**UV** - Ultraviolet

### V

**Vapor** - Gases formed from liquids at normal temperatures.

**Vapor density** - The weight of a vapor or gas compared to the weight of an equal volume of air.

**Vapor pressure** - The property of a material that determines whether it is a solid, liquid, or gas at normal temperatures and pressure.

**Ventilation** - The continuous movement of fresh, uncontaminated air throughout a confined space to eliminate or reduce atmospheric hazards.

**VHF** - Very high frequency

**VOC** - Volatile organic compound

**Volatility** - The ability of a chemical to evaporate. The more volatile a chemical, the more easily it passes from a liquid to a vapor state.

### W

**Water reactive material** - A material that is incompatible with water.

**Water table** - The boundary between the unsaturated zone and the saturated zone.

**WBGT Index** - Wet bulb globe temperature index

**Wipe test** - Test used to determine the amount of chemical contamination present on a surface, by drawing a sterile piece of gauze or filter paper across a surface.

**Workplace monitoring** - The process of collecting, detecting, and measuring the workplace for chemical, physical, and biological hazards.

**Work plan** - The plan that explains the actual clean-up process on a hazardous waste site

### X, Y, Z

**No entries**